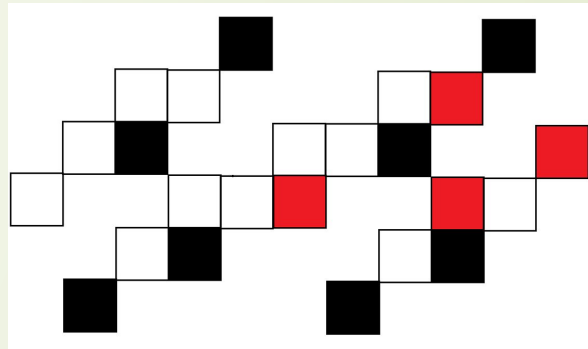


Linux

Basics of OS & RTOS

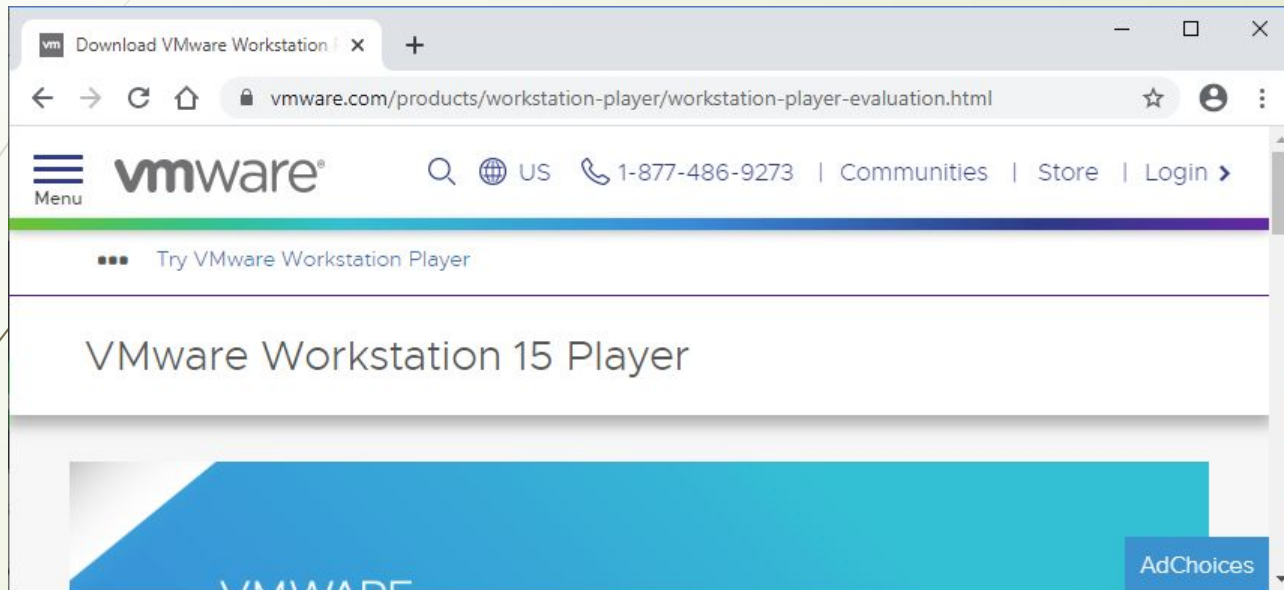
Kakelino's Code School

Linux Basics
Ubuntu
Vmware player



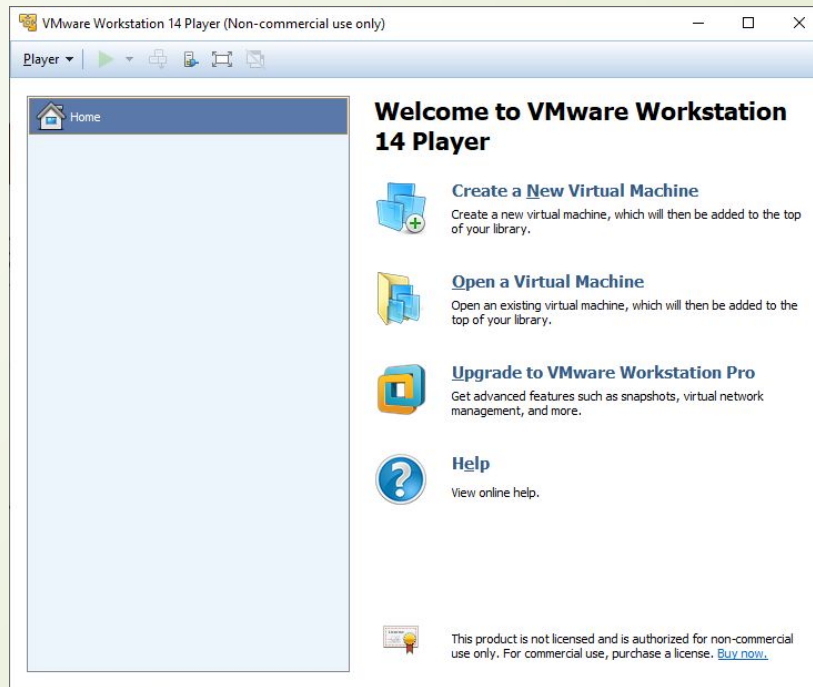
This is free!

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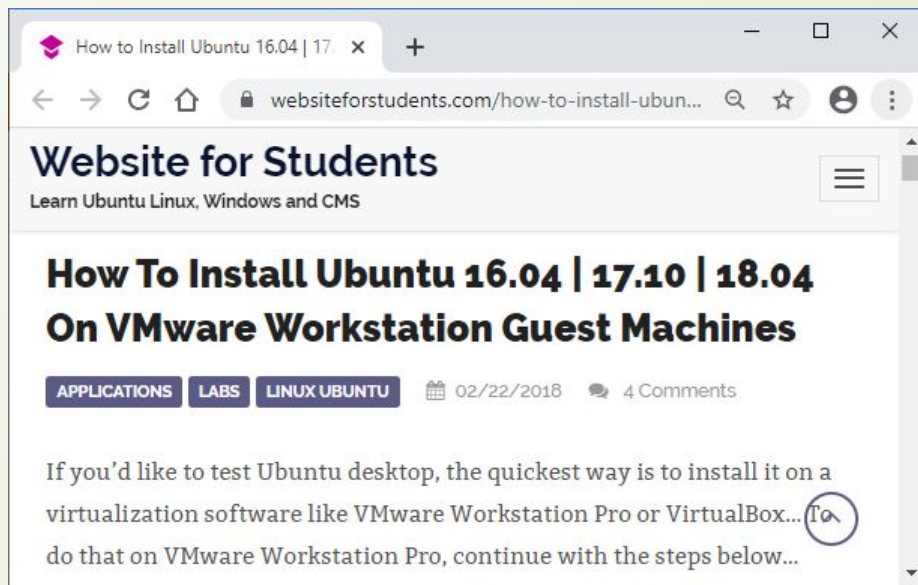
Operating Systems
VMPlayer & Linux



Kakelino's Code School

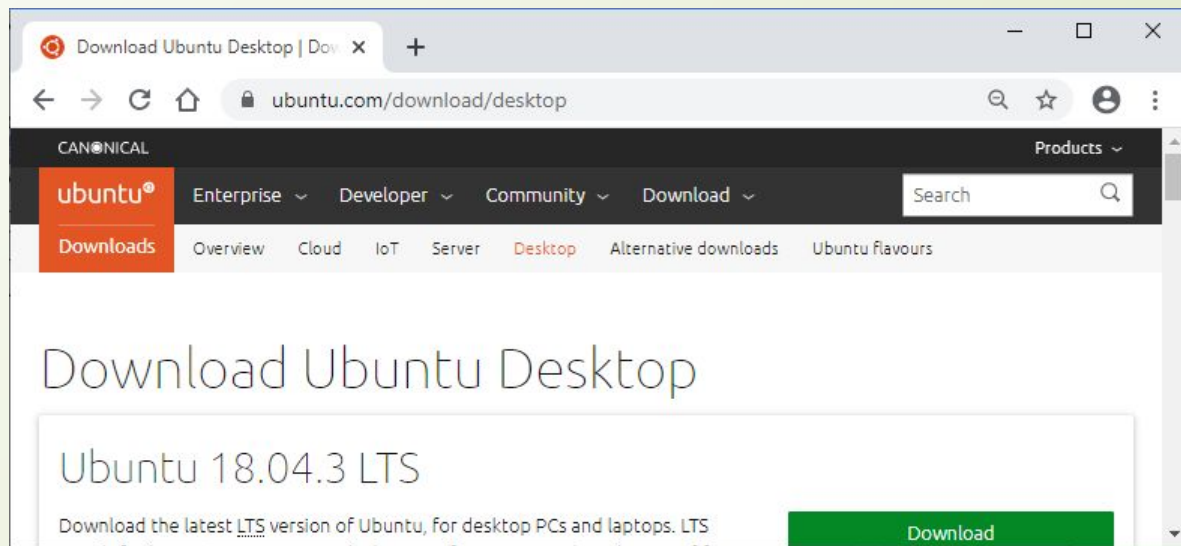
Operating Systems
VMPlayer & Linux

Good site!



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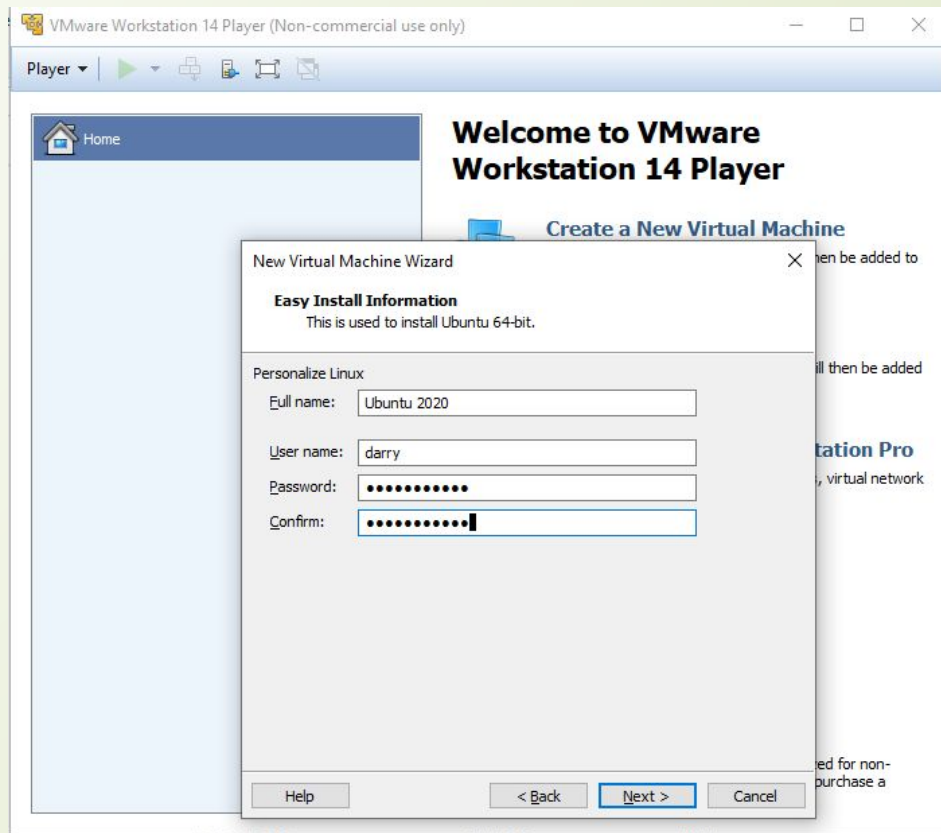
Operating Systems
VMPlayer & Linux



ubuntu-18.04.3-desktop-amd64.iso

Kakelino's Code School

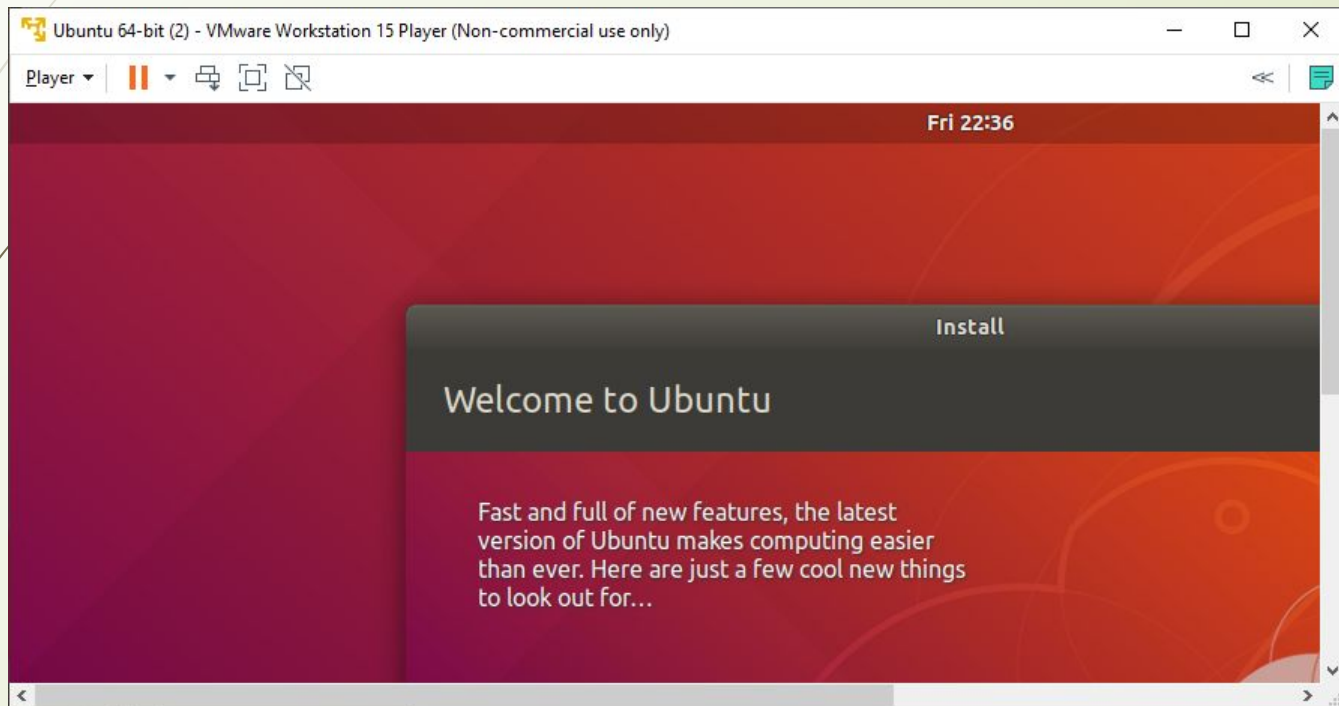
Operating Systems
VMPlayer & Linux



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Operating Systems
VMPlayer & Linux

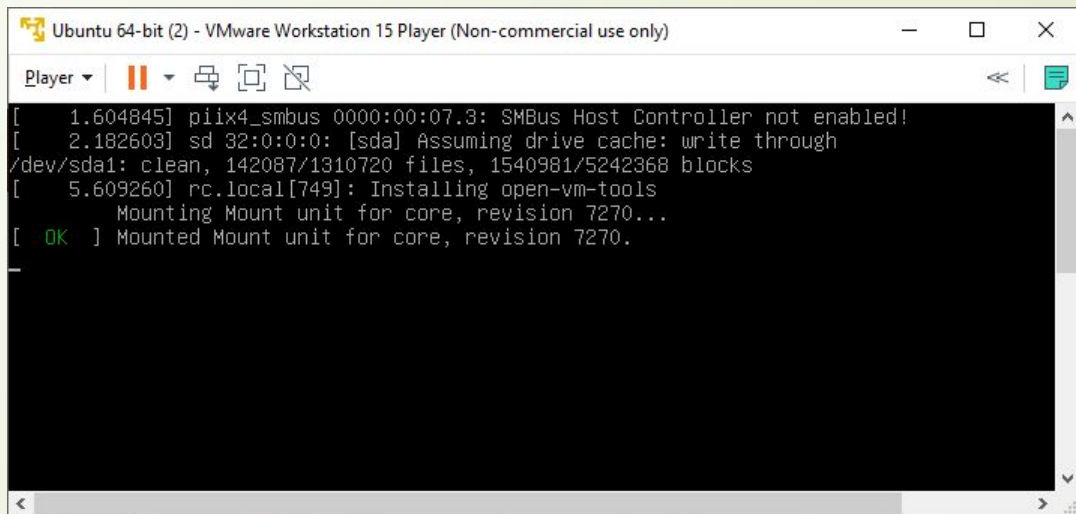
A lot of tools are installed!



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Operating Systems
VMPlayer & Linux

A lot of tools are installed!

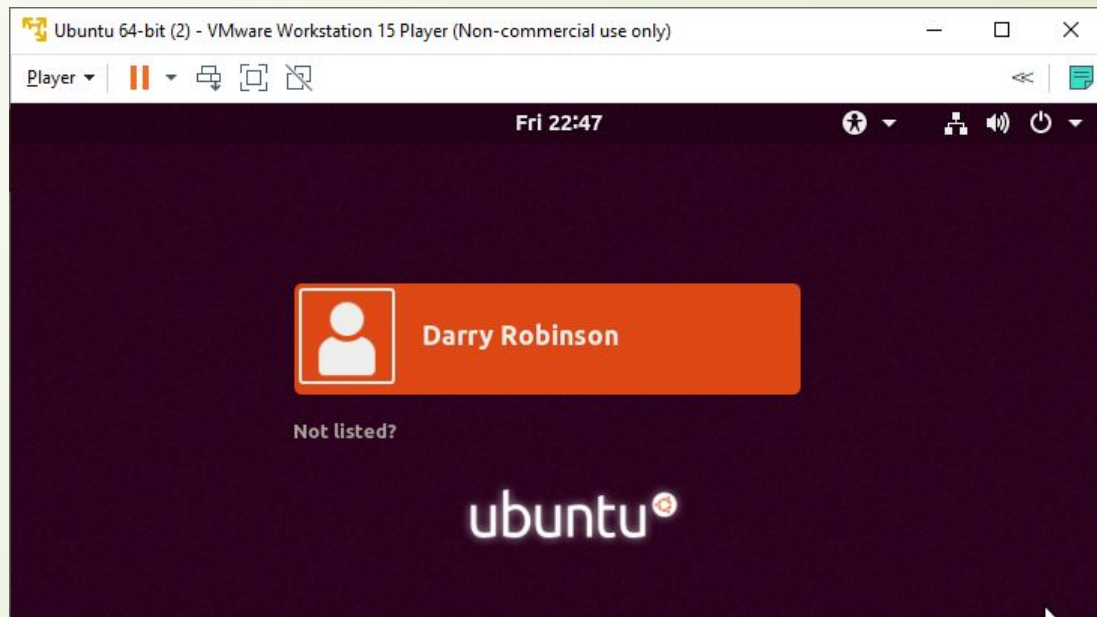


```
Ubuntu 64-bit (2) - VMware Workstation 15 Player (Non-commercial use only)
Player | [Pause] [Full Screen] [Close]
[ 1.604845] piix4_smbus 0000:00:07.3: SMBus Host Controller not enabled!
[ 2.182603] sd 32:0:0:0: [sda] Assuming drive cache: write through
/dev/sda1: clean, 142087/1310720 files, 1540981/5242368 blocks
[ 5.609260] rc.local[749]: Installing open-vm-tools
Mounting Mount unit for core, revision 7270...
[ OK ] Mounted Mount unit for core, revision 7270.
```

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Operating Systems
VMPlayer & Linux

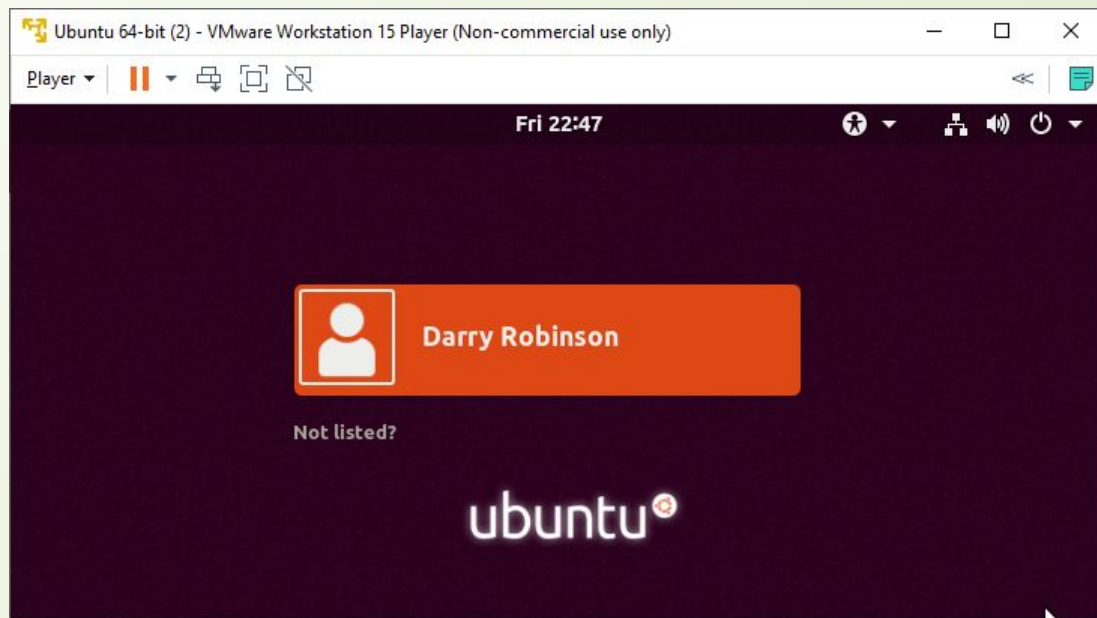
Finally!



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Operating Systems
VMPlayer & Linux

Finally!



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Operating Systems
VMPlayer & Linux

Nice!



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Operating Systems
VMPlayer & Linux

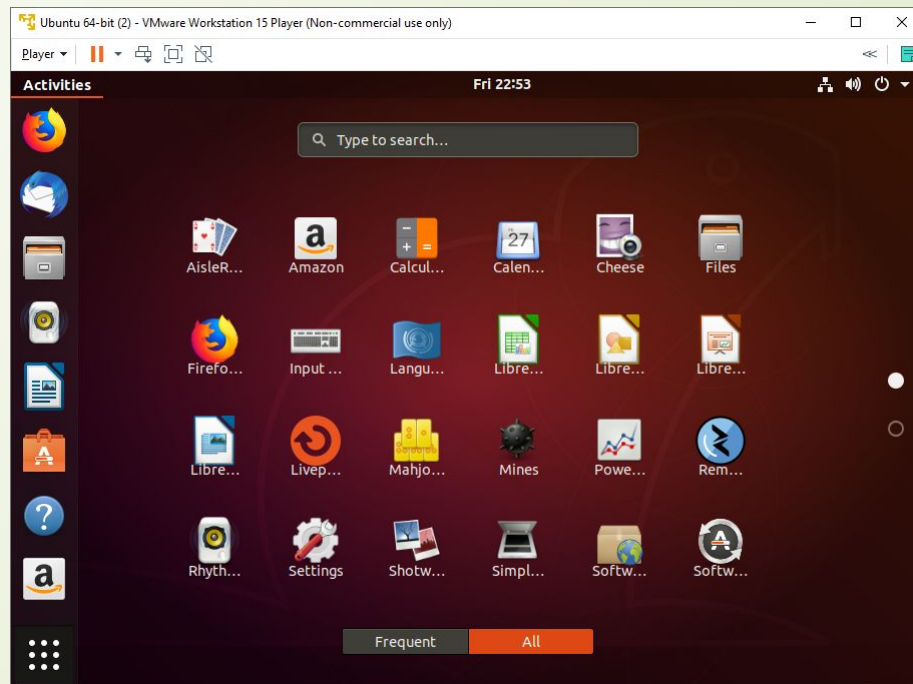
Nice!



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Operating Systems
VMPlayer & Linux

Nice!

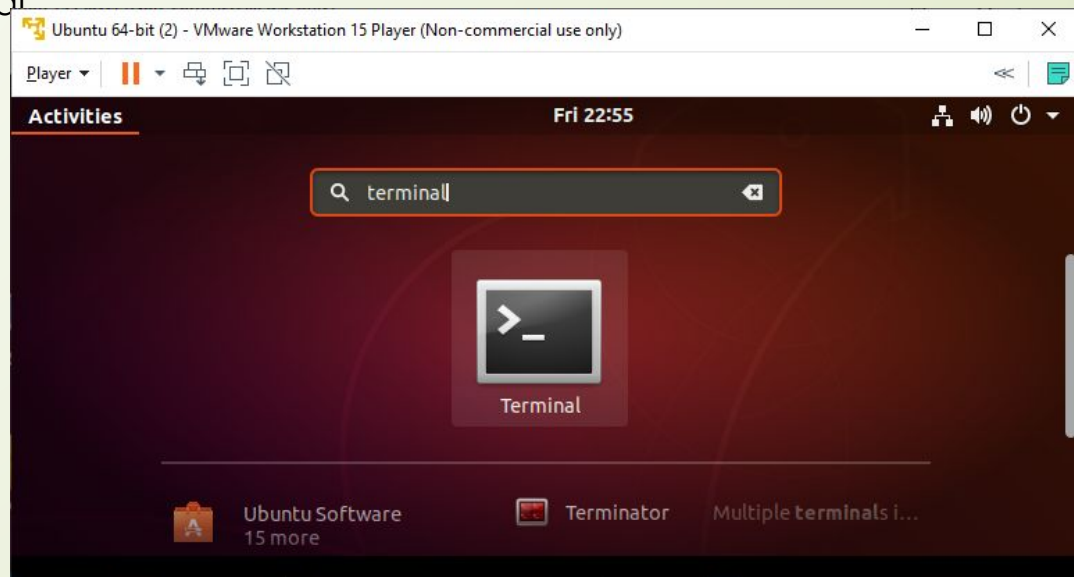


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Operating Systems
VMPlayer & Linux

Now, just try Linux!

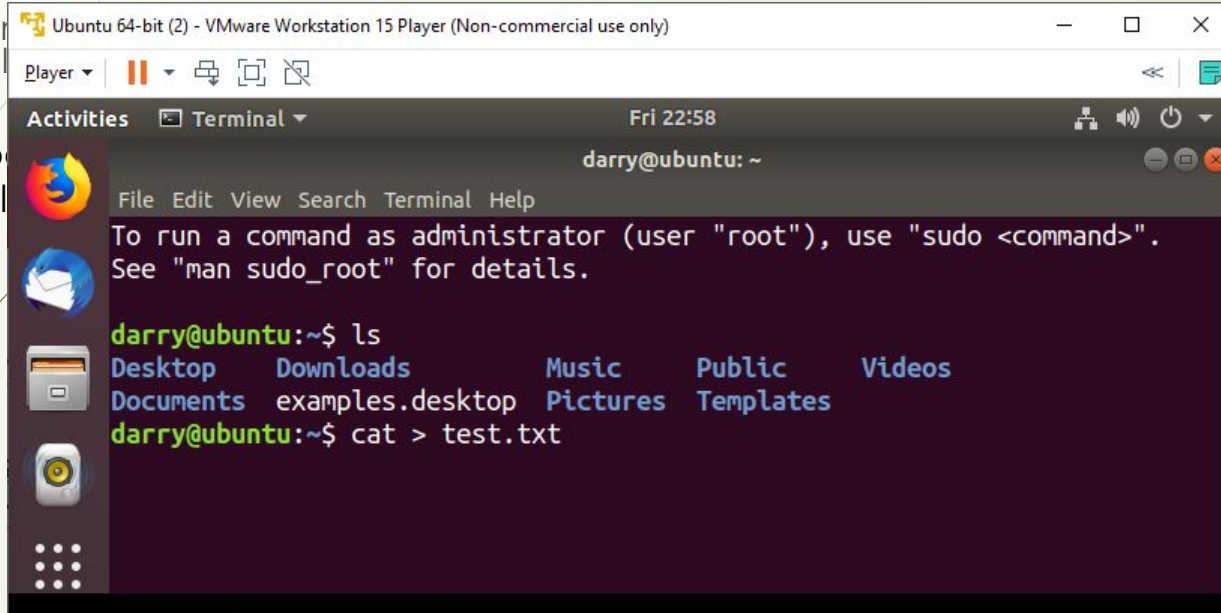
Let's do basic things
via console/terminal



Kakelino's Code School

Open
VMP

Let's do b
via consol



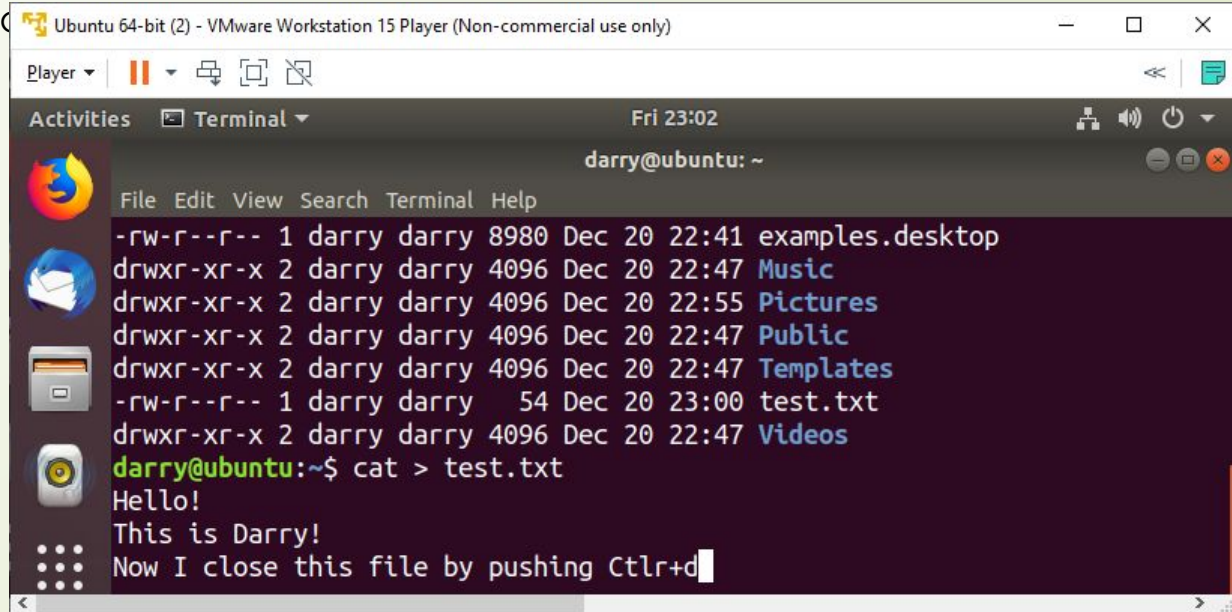
```
Ubuntu 64-bit (2) - VMware Workstation 15 Player (Non-commercial use only)
Player | || | |
Activities | Fri 22:58 |
Terminal | darry@ubuntu: ~ |
File Edit View Search Terminal Help
To run a command as administrator (user "root"), use "sudo <command>".
See "man sudo_root" for details.
darry@ubuntu:~$ ls
Desktop Downloads Music Public Videos
Documents examples.desktop Pictures Templates
darry@ubuntu:~$ cat > test.txt
```

Kakelino's Code School

Operating Systems
VMPlayer & Linux

Now, just try Linux!

Let's do basic things
via console/terminal



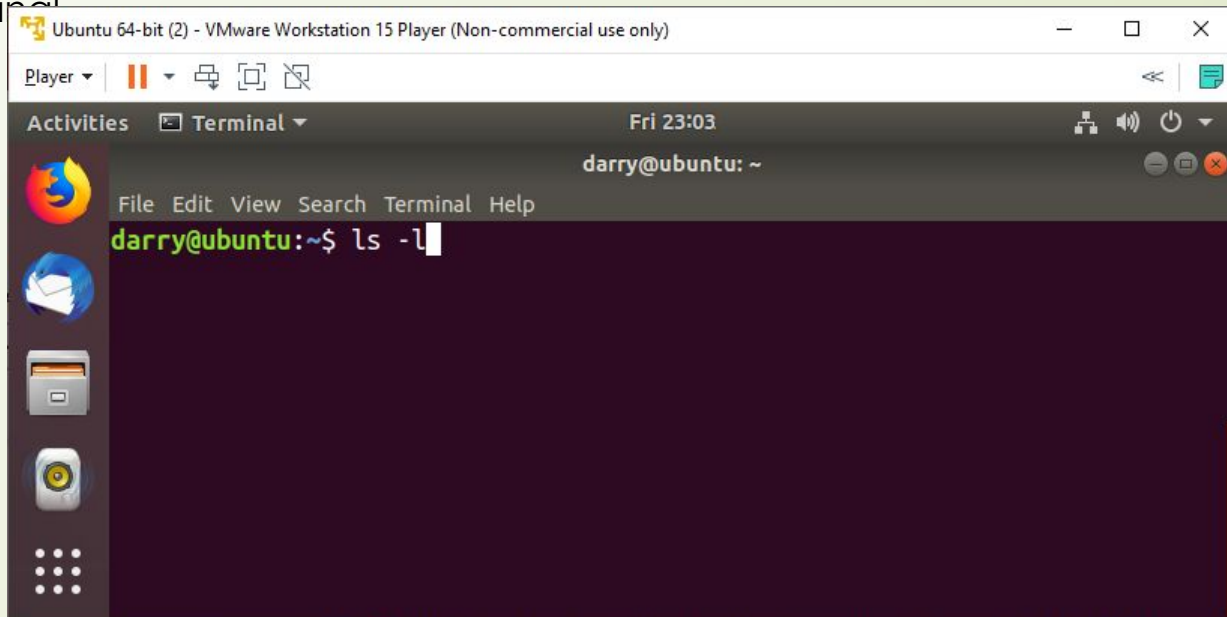
```
Ubuntu 64-bit (2) - VMware Workstation 15 Player (Non-commercial use only)
Player ▾ || ▾ ▴ ▹ ▸
Activities Terminal ▾ Fri 23:02 darry@ubuntu: ~
File Edit View Search Terminal Help
-rw-r--r-- 1 darry darry 8980 Dec 20 22:41 examples.desktop
drwxr-xr-x 2 darry darry 4096 Dec 20 22:47 Music
drwxr-xr-x 2 darry darry 4096 Dec 20 22:55 Pictures
drwxr-xr-x 2 darry darry 4096 Dec 20 22:47 Public
drwxr-xr-x 2 darry darry 4096 Dec 20 22:47 Templates
-rw-r--r-- 1 darry darry 54 Dec 20 23:00 test.txt
drwxr-xr-x 2 darry darry 4096 Dec 20 22:47 Videos
darry@ubuntu:~$ cat > test.txt
Hello!
This is Darry!
Now I close this file by pushing Ctrl+d
```

Kakelino's Code School

Operating Systems
VMPlayer & Linux

Now, just try Linux!

Let's do basic things
via console/terminal



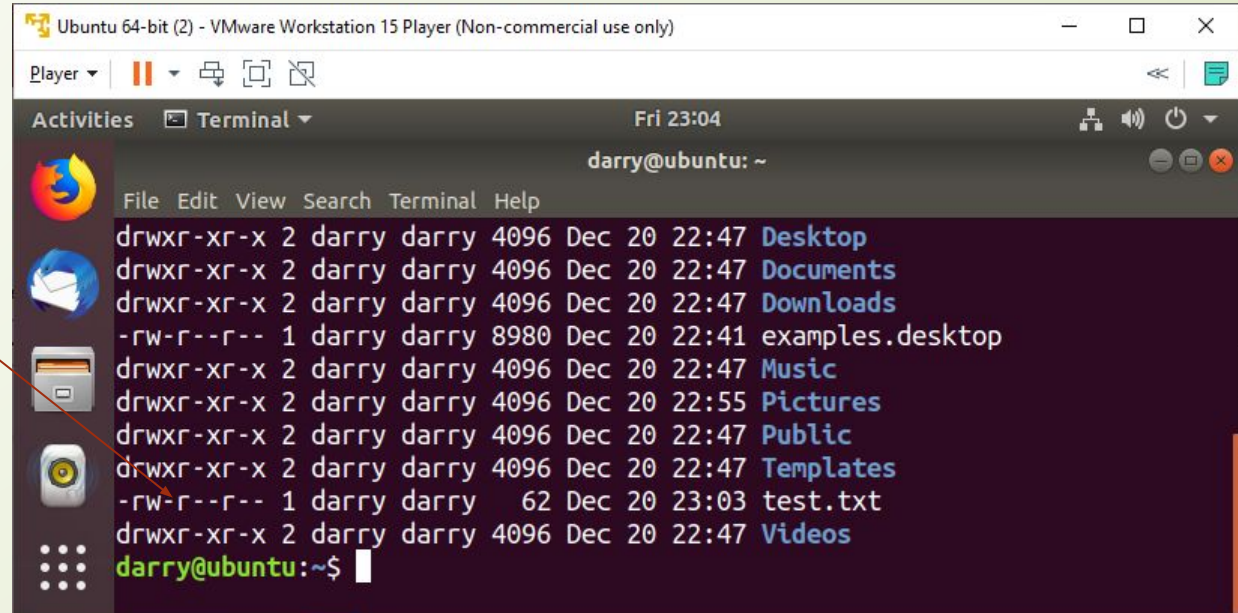
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Operating Systems
VMPlayer & Linux

Now, just try Linux!

Let's do basic things
via console/terminal

New
file



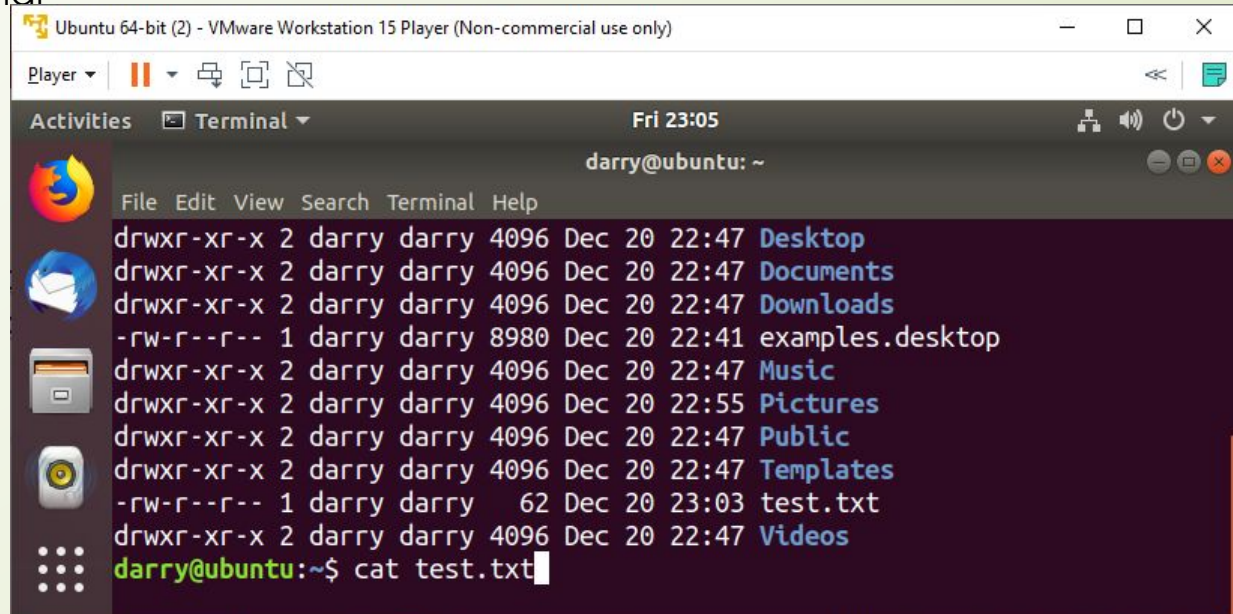
```
Ubuntu 64-bit (2) - VMware Workstation 15 Player (Non-commercial use only)
Player
Fri 23:04
darry@ubuntu: ~
File Edit View Search Terminal Help
drwxr-xr-x 2 darry darry 4096 Dec 20 22:47 Desktop
drwxr-xr-x 2 darry darry 4096 Dec 20 22:47 Documents
drwxr-xr-x 2 darry darry 4096 Dec 20 22:47 Downloads
-rw-r--r-- 1 darry darry 8980 Dec 20 22:41 examples.desktop
drwxr-xr-x 2 darry darry 4096 Dec 20 22:47 Music
drwxr-xr-x 2 darry darry 4096 Dec 20 22:55 Pictures
drwxr-xr-x 2 darry darry 4096 Dec 20 22:47 Public
drwxr-xr-x 2 darry darry 4096 Dec 20 22:47 Templates
-rw-r--r-- 1 darry darry 62 Dec 20 23:03 test.txt
drwxr-xr-x 2 darry darry 4096 Dec 20 22:47 Videos
darry@ubuntu:~$
```

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Operating Systems
VMPlayer & Linux

Now, just try Linux!

Let's do basic things
via console/terminal



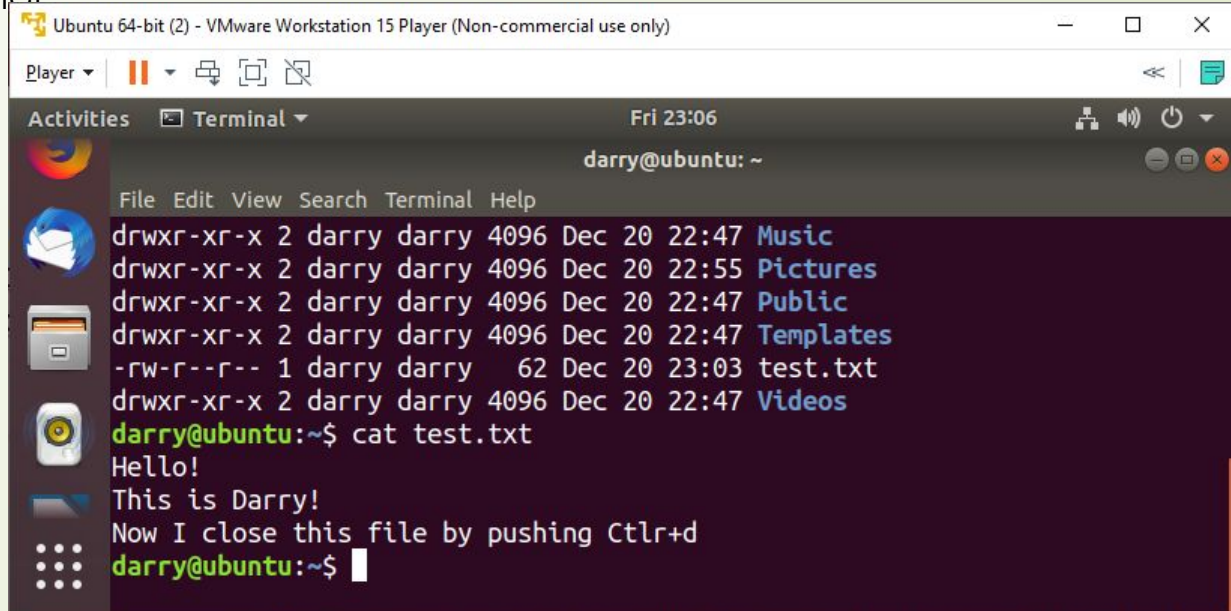
```
Ubuntu 64-bit (2) - VMware Workstation 15 Player (Non-commercial use only)
Player | [Icons]
Activities | Terminal
Fri 23:05
darry@ubuntu: ~
File Edit View Search Terminal Help
drwxr-xr-x 2 darry darry 4096 Dec 20 22:47 Desktop
drwxr-xr-x 2 darry darry 4096 Dec 20 22:47 Documents
drwxr-xr-x 2 darry darry 4096 Dec 20 22:47 Downloads
-rw-r--r-- 1 darry darry 8980 Dec 20 22:41 examples.desktop
drwxr-xr-x 2 darry darry 4096 Dec 20 22:47 Music
drwxr-xr-x 2 darry darry 4096 Dec 20 22:55 Pictures
drwxr-xr-x 2 darry darry 4096 Dec 20 22:47 Public
drwxr-xr-x 2 darry darry 4096 Dec 20 22:47 Templates
-rw-r--r-- 1 darry darry 62 Dec 20 23:03 test.txt
drwxr-xr-x 2 darry darry 4096 Dec 20 22:47 Videos
darry@ubuntu:~$ cat test.txt
```

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Operating Systems
VMPlayer & Linux

Now, just try Linux!

Let's do basic things
via console/terminal



```
Ubuntu 64-bit (2) - VMware Workstation 15 Player (Non-commercial use only)
Player ▾ || ▾ ▴ ▴ ▴
Activities ▾ Terminal ▾ Fri 23:06
darry@ubuntu: ~
File Edit View Search Terminal Help
drwxr-xr-x 2 darry darry 4096 Dec 20 22:47 Music
drwxr-xr-x 2 darry darry 4096 Dec 20 22:55 Pictures
drwxr-xr-x 2 darry darry 4096 Dec 20 22:47 Public
drwxr-xr-x 2 darry darry 4096 Dec 20 22:47 Templates
-rw-r--r-- 1 darry darry 62 Dec 20 23:03 test.txt
drwxr-xr-x 2 darry darry 4096 Dec 20 22:47 Videos
darry@ubuntu:~$ cat test.txt
Hello!
This is Darry!
Now I close this file by pushing Ctrl+d
darry@ubuntu:~$
```

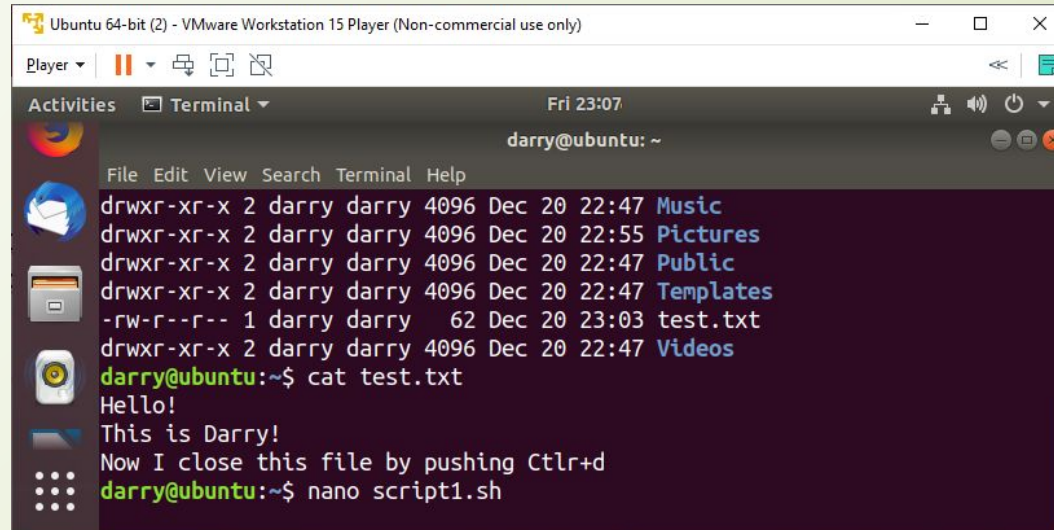
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Operating Systems
VMPlayer & Linux

Let's do basic things
via console/terminal

Let's create a
Bourne shell script!

Now, just try Linux!



```
Ubuntu 64-bit (2) - VMware Workstation 15 Player (Non-commercial use only)
Player ▾  ||  🖨  📄  🗑
Activities  Terminal ▾  Fri 23:07  🔊 🔌 🔍
darry@ubuntu: ~
File Edit View Search Terminal Help
drwxr-xr-x 2 darry darry 4096 Dec 20 22:47 Music
drwxr-xr-x 2 darry darry 4096 Dec 20 22:55 Pictures
drwxr-xr-x 2 darry darry 4096 Dec 20 22:47 Public
drwxr-xr-x 2 darry darry 4096 Dec 20 22:47 Templates
-rw-r--r-- 1 darry darry 62 Dec 20 23:03 test.txt
drwxr-xr-x 2 darry darry 4096 Dec 20 22:47 Videos
darry@ubuntu:~$ cat test.txt
Hello!
This is Darry!
Now I close this file by pushing Ctrl+d
darry@ubuntu:~$ nano script1.sh
```

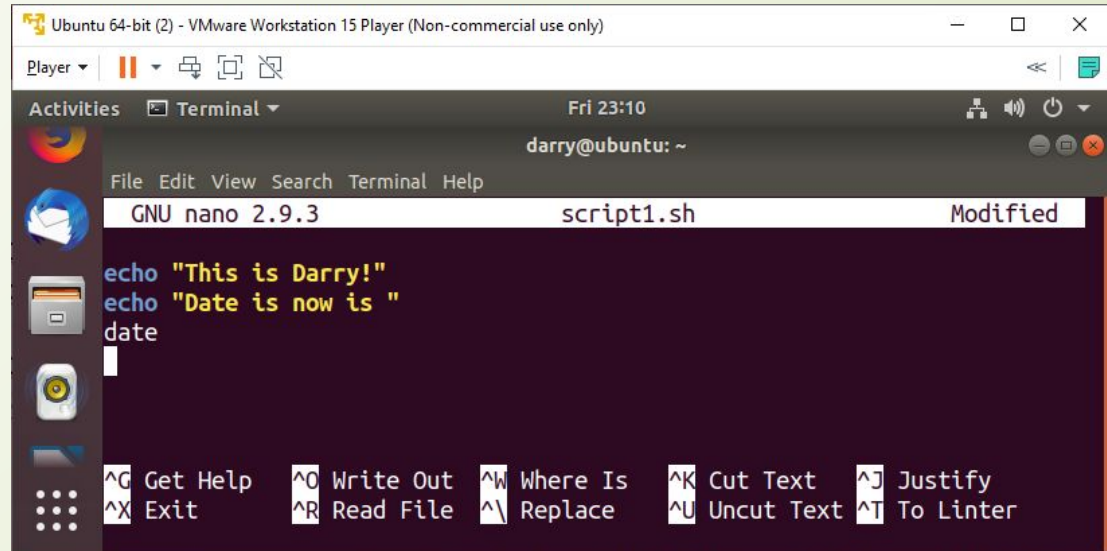
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Operating Systems
VMPlayer & Linux

Let's do basic things
via console/terminal

Let's create a
Bourne shell script!

Now, just try Linux!



```
Ubuntu 64-bit (2) - VMware Workstation 15 Player (Non-commercial use only)
Player
Activities Terminal
Fri 23:10
darry@ubuntu: ~
File Edit View Search Terminal Help
GNU nano 2.9.3 script1.sh Modified
echo "This is Darry!"
echo "Date is now is "
date
^G Get Help ^O Write Out ^W Where Is ^K Cut Text ^J Justify
^X Exit ^R Read File ^\ Replace ^U Uncut Text ^T To Linter
```

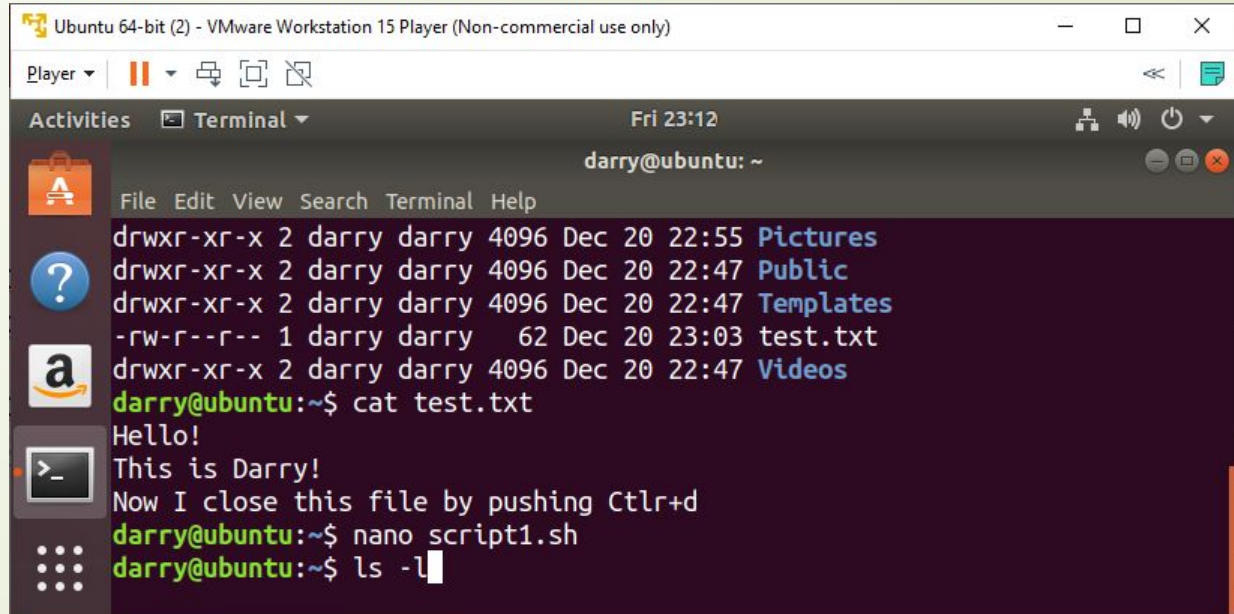
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Operating Systems
VMPlayer & Linux

Now, just try Linux!

Let's do basic things
via console/terminal

Let's create a
Bourne shell script!



```
Ubuntu 64-bit (2) - VMware Workstation 15 Player (Non-commercial use only)
Player
Fri 23:12
darry@ubuntu: ~
File Edit View Search Terminal Help
drwxr-xr-x 2 darry darry 4096 Dec 20 22:55 Pictures
drwxr-xr-x 2 darry darry 4096 Dec 20 22:47 Public
drwxr-xr-x 2 darry darry 4096 Dec 20 22:47 Templates
-rw-r--r-- 1 darry darry 62 Dec 20 23:03 test.txt
drwxr-xr-x 2 darry darry 4096 Dec 20 22:47 Videos
darry@ubuntu:~$ cat test.txt
Hello!
This is Darry!
Now I close this file by pushing Ctrl+d
darry@ubuntu:~$ nano script1.sh
darry@ubuntu:~$ ls -l
```

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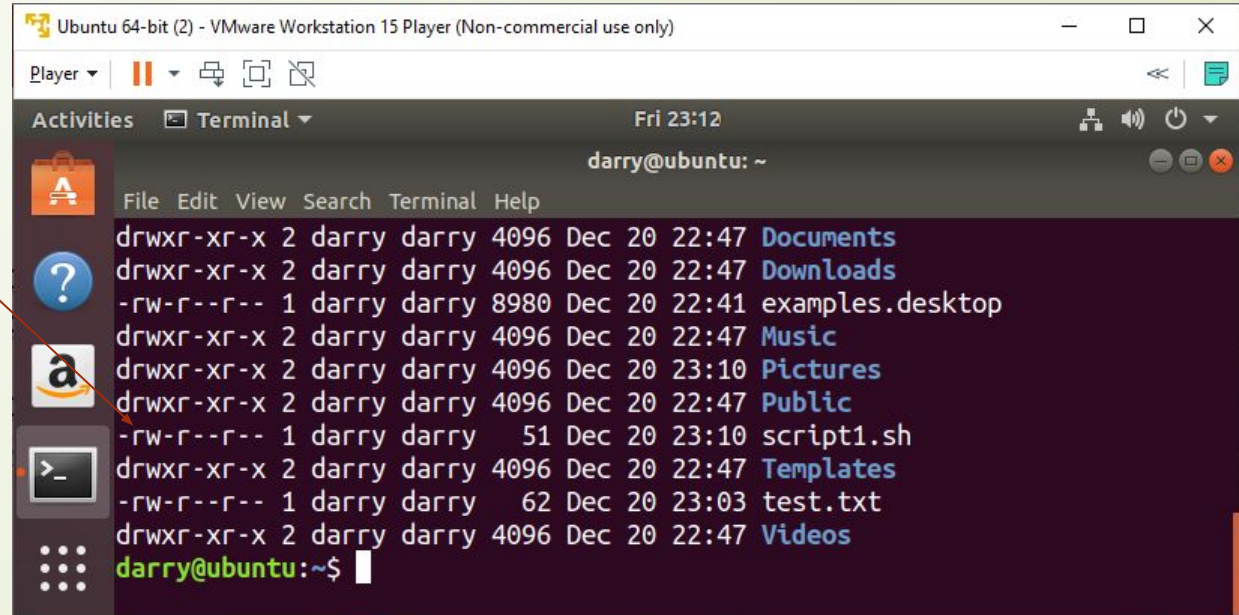
Operating Systems
VMPlayer & Linux

Now, just try Linux!

Let's do basic things
via console/terminal

Let's create a
Bourne shell script!

Execution
right
missing!



```
Ubuntu 64-bit (2) - VMware Workstation 15 Player (Non-commercial use only)
Player | [Icons]
Activities | Terminal | Fri 23:12
darry@ubuntu: ~
File Edit View Search Terminal Help
drwxr-xr-x 2 darry darry 4096 Dec 20 22:47 Documents
drwxr-xr-x 2 darry darry 4096 Dec 20 22:47 Downloads
-rw-r--r-- 1 darry darry 8980 Dec 20 22:41 examples.desktop
drwxr-xr-x 2 darry darry 4096 Dec 20 22:47 Music
drwxr-xr-x 2 darry darry 4096 Dec 20 23:10 Pictures
drwxr-xr-x 2 darry darry 4096 Dec 20 22:47 Public
-rw-r--r-- 1 darry darry 51 Dec 20 23:10 script1.sh
drwxr-xr-x 2 darry darry 4096 Dec 20 22:47 Templates
-rw-r--r-- 1 darry darry 62 Dec 20 23:03 test.txt
drwxr-xr-x 2 darry darry 4096 Dec 20 22:47 Videos
darry@ubuntu:~$
```

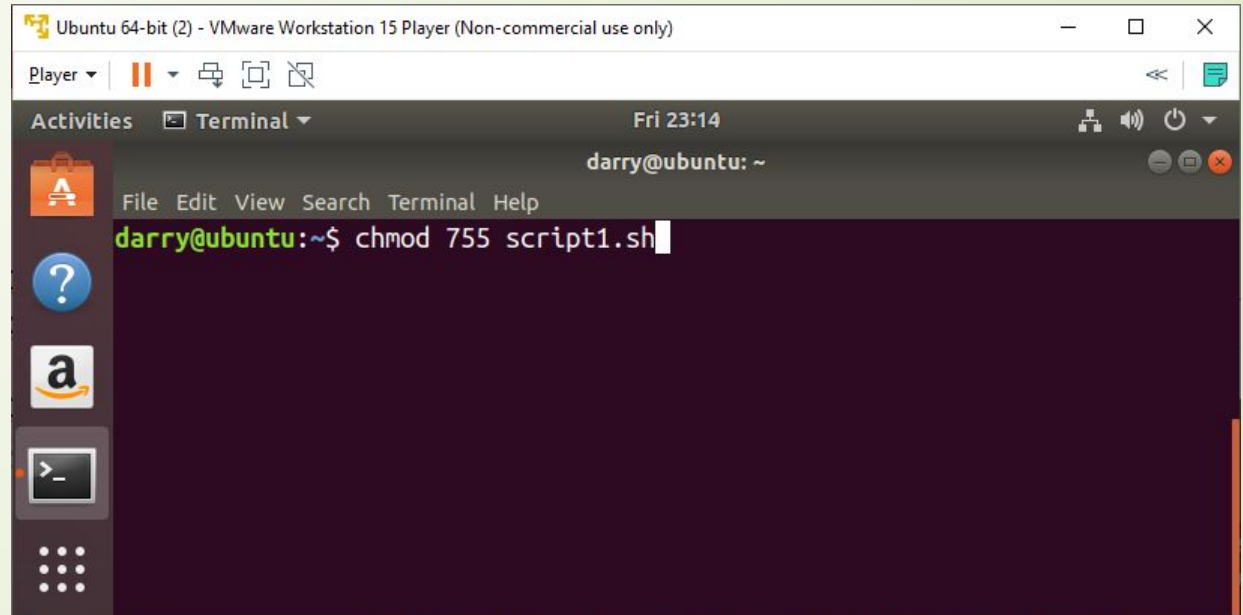
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Operating Systems
VMPlayer & Linux

Now, just try Linux!

Let's do basic things
via console/terminal

Let's create a
Bourne shell script!



```
Ubuntu 64-bit (2) - VMware Workstation 15 Player (Non-commercial use only)
Player
Activities Terminal
darry@ubuntu: ~
File Edit View Search Terminal Help
darry@ubuntu:~$ chmod 755 script1.sh
```

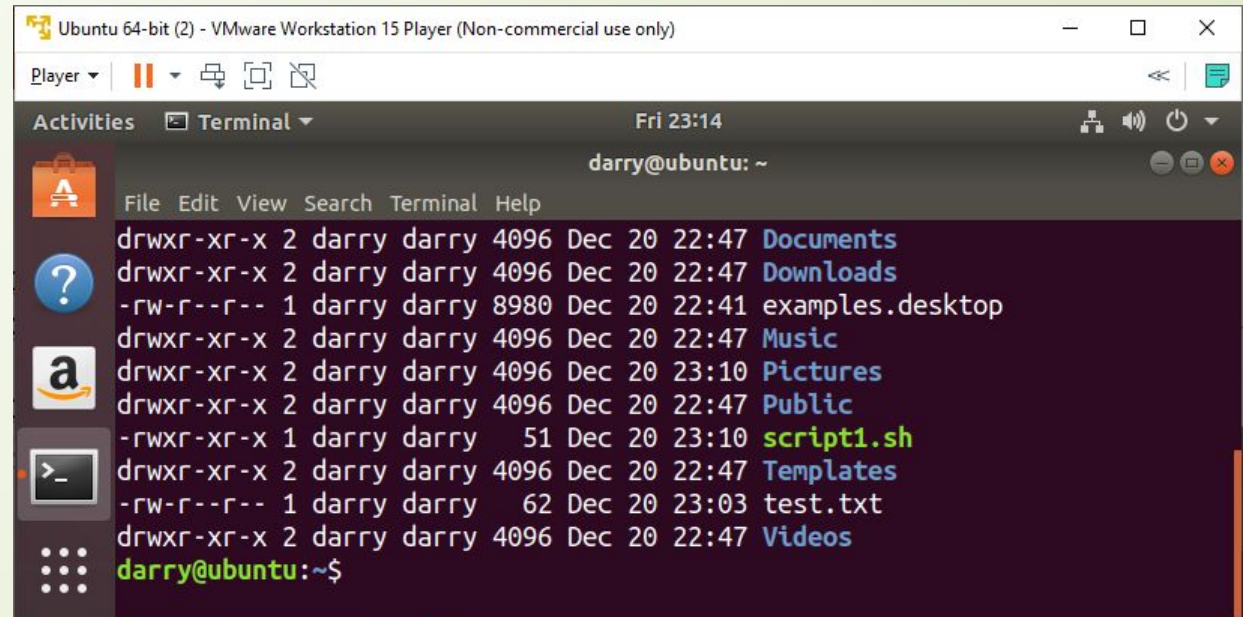
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Operating Systems
VMPlayer & Linux

Now, just try Linux!

Let's do basic things
via console/terminal

Let's create a
Bourne shell script!



```
Ubuntu 64-bit (2) - VMware Workstation 15 Player (Non-commercial use only)
Player ▾ | [Icons]
Activities [Terminal] ▾ | Fri 23:14 | [Icons]
darry@ubuntu: ~
File Edit View Search Terminal Help
drwxr-xr-x 2 darry darry 4096 Dec 20 22:47 Documents
drwxr-xr-x 2 darry darry 4096 Dec 20 22:47 Downloads
-rw-r--r-- 1 darry darry 8980 Dec 20 22:41 examples.desktop
drwxr-xr-x 2 darry darry 4096 Dec 20 22:47 Music
drwxr-xr-x 2 darry darry 4096 Dec 20 23:10 Pictures
drwxr-xr-x 2 darry darry 4096 Dec 20 22:47 Public
-rwxr-xr-x 1 darry darry 51 Dec 20 23:10 script1.sh
drwxr-xr-x 2 darry darry 4096 Dec 20 22:47 Templates
-rw-r--r-- 1 darry darry 62 Dec 20 23:03 test.txt
drwxr-xr-x 2 darry darry 4096 Dec 20 22:47 Videos
darry@ubuntu:~$
```

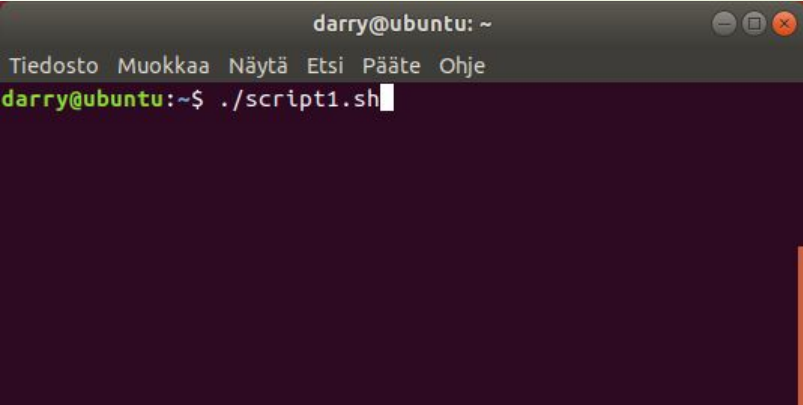
Kakelino's Code School

Operating Systems
VMPlayer & Linux

Now, just try Linux!

Let's do basic things
via console/terminal

Let's create a
Bourne shell script!



```
darry@ubuntu: ~  
Tiedosto Muokkaa Näytä Etsi Pääte Ohje  
darry@ubuntu:~$ ./script1.sh
```



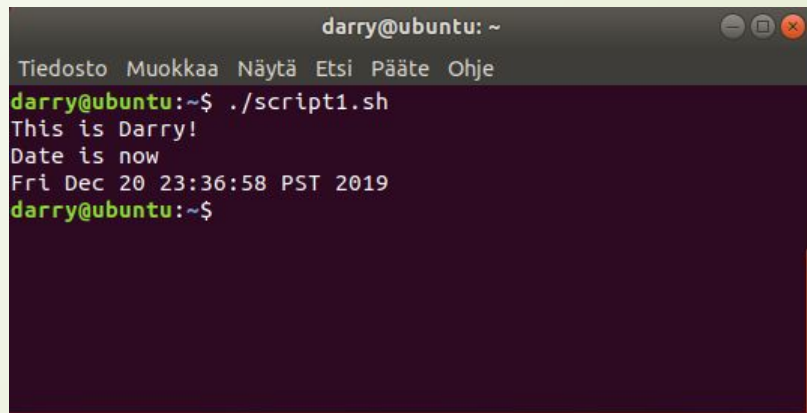
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Operating Systems
VMPlayer & Linux

Now, just try Linux!

Let's do basic things
via console/terminal

Let's create a
Bourne shell script!

A terminal window titled 'darry@ubuntu: ~' with standard window controls. The menu bar includes 'Tiedosto', 'Muokkaa', 'Näytä', 'Etsi', 'Pääte', and 'Ohje'. The terminal shows the command './script1.sh' being executed, which outputs 'This is Darry!', 'Date is now', and 'Fri Dec 20 23:36:58 PST 2019'.

```
darry@ubuntu: ~  
Tiedosto Muokkaa Näytä Etsi Pääte Ohje  
darry@ubuntu:~$ ./script1.sh  
This is Darry!  
Date is now  
Fri Dec 20 23:36:58 PST 2019  
darry@ubuntu:~$
```



Kakelino's Code School

Operating Systems
VMPlayer & Linux

Let's do basic things
via console/terminal

Now, just try Linux!

Go on and study Linux!

Create also scripts to help root's life!





Give feedback, please!
Give ideas, proposals for new
guides!

JavaScript

PHP

C

C#

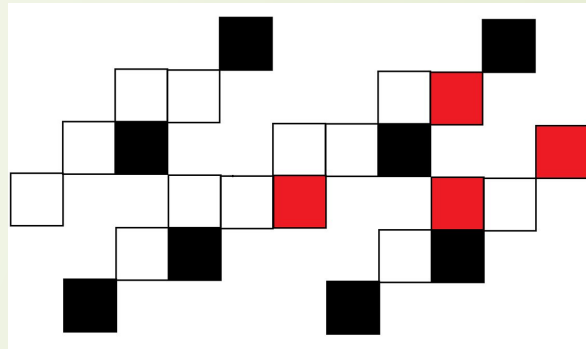
C++

Java

Python

Kakelino's Code School

Linux Basics
Ubuntu
Vmware player



This is free!



Kakelino's Code School

Linux Basics
Ubuntu
Vmware player

Bourne shell scripts



Kakelino's Code School

Linux Basics
Ubuntu
Vmware player

Bourne shell scripts

```
echo 'Hello again'
# variable
name="Darry"
echo $name
# move to root folder and print contents
cd /
echo "path is now"
pwd
ls

#move back to home folder
cd $home
echo "path is now"
pwd
ls
```

Kakelino's Code School

Linux Basics
Ubuntu
Vmware player

Bourne shell scripts

```
echo 'Hello again'
# variable
name="Darry"
echo $name
# move to root folder and print contents
cd /
echo "path is now"
pwd
ls

#move back to home folder
cd $home
echo "path is now"
pwd
ls
```

```
darry@ubuntu:~$ nano script2.sh
darry@ubuntu:~$ ./script2.sh
Hello again
Darry
path is now
/
bin      etc          lib          mnt      run      swapfile    var
boot     home          lib64        opt      sbin     sys         vmlinuz
cdrom    initrd.img    lost+found   proc     snap     tmp         vmlinuz.old
dev      initrd.img.old media        root     srv      usr

path is now
/home/darry
Desktop  Downloads      Music          Public          script2.sh  test.txt
Documents examples.desktop Pictures        script1.sh  Templates  Videos
darry@ubuntu:~$
```



Kakelino's Code School

Linux Basics
Ubuntu
Vmware player

Bourne shell scripts

```
# loop: let's print series 1,3,5,...21
i=1

while [ $i -lt 23 ]
do
    echo $i
    i=`expr $i + 2`
done
```

Kakelino's Code School

Linux Basics
Ubuntu
Vmware player

Bourne shell scripts



```
# loop: let's print series 1,3,5,...21
i=1

while [ $i -lt 23 ]
do
    echo $i
    i=`expr $i + 2`
done
```

```
darry@ubuntu:~$ ./script3.sh
1
3
5
7
9
11
13
15
17
19
21
darry@ubuntu:~$
```



Kakelino's Code School

Linux Basics
Ubuntu
Vmware player

Bourne shell scripts

```
# ask user what to do
echo "Choose, please"

v=100
while [ $v -ne 0 ]
do
    echo "Menu"
    echo "1 = list all files "
    echo "2 = create folder named temp "
    echo "3 = print current time "
    echo "4 = visitors "
    echo "5 = list processes "
    echo "0 = exit "

    echo "your choice?"
    read v
case $v in
    1) ls -la;;
    2) mkdir temp ;;
    3) date;;
    4) who;;
    5) ps;;
    0) break;;
    *) echo "wrong number";;
esac
done
```

Kakelino's Code School

Linux Basics

Ubuntu

Vmware player

Bourne shell scripts

```
# ask user what to do
echo "Choose, please"

v=100
while [ $v -ne 0 ]
do
    echo "Menu"
    echo "1 = list all files "
    echo "2 = create folder named temp "
    echo "3 = print current time "
    echo "4 = visitors "
    echo "5 = list processes "
    echo "0 = exit "

    echo "your choice?"
    read v
    case $v in
        1) ls -la;;
        2) mkdir temp ;;
        3) date;;
        4) who;;
        5) ps;;
        0) break;;
        *) echo "wrong number";;
    esac
done
```

```
darry@ubuntu:~$ ./script4.sh
Choose, please
Menu
1 = list all files
2 = create folder named temp
3 = print current time
4 = visitors
5 = list processes
0 = exit
your choice?
5
    PID TTY          TIME CMD
  2788 pts/0        00:00:00 bash
 107910 pts/0        00:00:00 bash
 107911 pts/0        00:00:00 ps
Menu
1 = list all files
2 = create folder named temp
3 = print current time
4 = visitors
5 = list processes
0 = exit
your choice?
```

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Linux Basics
Ubuntu
Vmware player

Timing with at

```
sudo apt install at
```

```
darry@ubuntu:~$ at now +1 minute
warning: commands will be executed using /bin/sh
at> ls > files.txt
at> <EOT>
job 1 at Mon Dec 23 01:34:00 2019
darry@ubuntu:~$
```

```
darry@ubuntu:~$ ls -l
yhteensä 72
drwxr-xr-x 2 darry darry 4096 Dec 20 22:47 Desktop
drwxr-xr-x 2 darry darry 4096 Dec 20 22:47 Documents
drwxr-xr-x 2 darry darry 4096 Dec 20 22:47 Downloads
-rw-r--r-- 1 darry darry 8980 Dec 20 22:41 examples.desktop
-rw-r--r-- 1 darry darry 152 Dec 23 01:34 files.txt
drwxr-xr-x 2 darry darry 4096 Dec 20 22:47 Music
drwxr-xr-x 2 darry darry 4096 Dec 23 01:04 Pictures
drwxr-xr-x 2 darry darry 4096 Dec 20 22:47 Public
-rwxr-xr-x 1 darry darry 50 Dec 20 23:35 script1.sh
-rwxr-xr-x 1 darry darry 191 Dec 23 01:00 script2.sh
-rwxr-xr-x 1 darry darry 102 Dec 23 01:16 script3.sh
-rwxr-xr-x 1 darry darry 421 Dec 23 01:29 script4.sh
drwxr-xr-x 2 darry darry 4096 Dec 23 01:29 temp
drwxr-xr-x 2 darry darry 4096 Dec 20 22:47 Templates
-rw-r--r-- 1 darry darry 62 Dec 20 23:03 test.txt
drwxr-xr-x 2 darry darry 4096 Dec 20 22:47 Videos
```

Kakelino's Code School

Linux Basics
Ubuntu
Vmware player

Timing with at

```
darry@ubuntu:~$ ls -l
yhteensä 72
drwxr-xr-x 2 darry darry 4096 Dec 20 22:47 Desktop
drwxr-xr-x 2 darry darry 4096 Dec 20 22:47 Documents
drwxr-xr-x 2 darry darry 4096 Dec 20 22:47 Downloads
-rw-r--r-- 1 darry darry 8980 Dec 20 22:41 examples.desktop
-rw-r--r-- 1 darry darry 152 Dec 23 01:34 files.txt
drwxr-xr-x 2 darry darry 4096 Dec 20 22:47 Music
drwxr-xr-x 2 darry darry 4096 Dec 23 01:04 Pictures
drwxr-xr-x 2 darry darry 4096 Dec 20 22:47 Public
-rwxr-xr-x 1 darry darry 50 Dec 20 23:35 script1.sh
-rwxr-xr-x 1 darry darry 191 Dec 23 01:00 script2.sh
-rwxr-xr-x 1 darry darry 102 Dec 23 01:16 script3.sh
-rwxr-xr-x 1 darry darry 421 Dec 23 01:29 script4.sh
drwxr-xr-x 2 darry darry 4096 Dec 23 01:29 temp
drwxr-xr-x 2 darry darry 4096 Dec 20 22:47 Templates
-rw-r--r-- 1 darry darry 62 Dec 20 23:03 test.txt
drwxr-xr-x 2 darry darry 4096 Dec 20 22:47 Videos
```

```
darry@ubuntu:~$ cat files.txt
Desktop
Documents
Downloads
examples.desktop
files.txt
Music
Pictures
Public
script1.sh
script2.sh
script3.sh
script4.sh
temp
Templates
test.txt
Videos
```

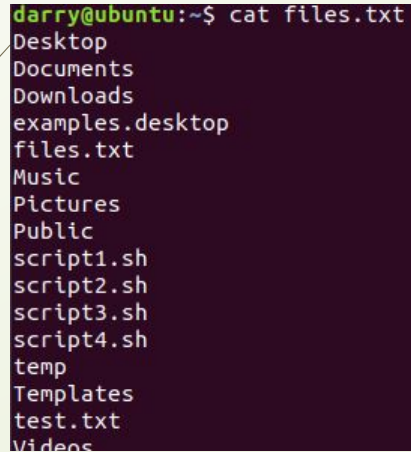
Kakelino's Code School

Linux Basics

Ubuntu

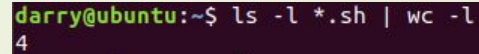
Vmware player

Pipe

A terminal window with a dark purple background. The prompt is 'darry@ubuntu:~\$'. The command 'cat files.txt' has been executed, and the output is a list of files and directories: Desktop, Documents, Downloads, examples.desktop, files.txt, Music, Pictures, Public, script1.sh, script2.sh, script3.sh, script4.sh, temp, Templates, test.txt, and videos.

```
darry@ubuntu:~$ cat files.txt
Desktop
Documents
Downloads
examples.desktop
files.txt
Music
Pictures
Public
script1.sh
script2.sh
script3.sh
script4.sh
temp
Templates
test.txt
videos
```

How many script
files are there?

A terminal window with a dark purple background. The prompt is 'darry@ubuntu:~\$'. The command 'ls -l *.sh | wc -l' has been executed, and the output is the number '4', indicating there are four script files.

```
darry@ubuntu:~$ ls -l *.sh | wc -l
4
```

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Linux Basics
Ubuntu
Vmware player

Find: powerful
command

```
darry@ubuntu:~$ find ./ -name \*.sh -exec touch {} \;  
darry@ubuntu:~$ ls -l *.sh  
-rwxr-xr-x 1 darry darry 50 Dec 23 01:57 script1.sh  
-rwxr-xr-x 1 darry darry 191 Dec 23 01:57 script2.sh  
-rwxr-xr-x 1 darry darry 102 Dec 23 01:57 script3.sh  
-rwxr-xr-x 1 darry darry 421 Dec 23 01:57 script4.sh
```

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Linux Basics
Ubuntu
Vmware player

Banner: funny
command

```
darry@ubuntu:~$ banner Darry
#####
#      #      ##      #####      #      #
#      #      #      #      #      #      #
#      #      #      #      #      #      #
#      #      #####      #####      #
#      #      #      #      #      #      #
#####      #      #      #      #      #
```

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Linux Basics

Ubuntu

Vmware player

C program

```
darry@ubuntu:~$ gcc p1.c -o p1.exe
```

```
#include <stdio.h>
int main()
{
    printf("\n This is Darry! Hello\n");
    return 0;
}
```

```
darry@ubuntu:~$ ./p1.exe
```

```
    This is Darry! Hello
darry@ubuntu:~$
```



Kakelino's Code School

Operating Systems
VMPlayer & Linux

Now, just try Linux!

Go on and study more Linux!

Create also more scripts to help root's
life!



Kakelino's Code School

Give feedback, please!
Give ideas, proposals for new
guides!

JavaScript

PHP

C

C#

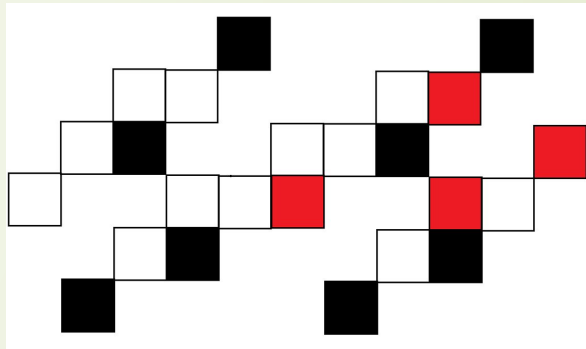
C++

Java

Python

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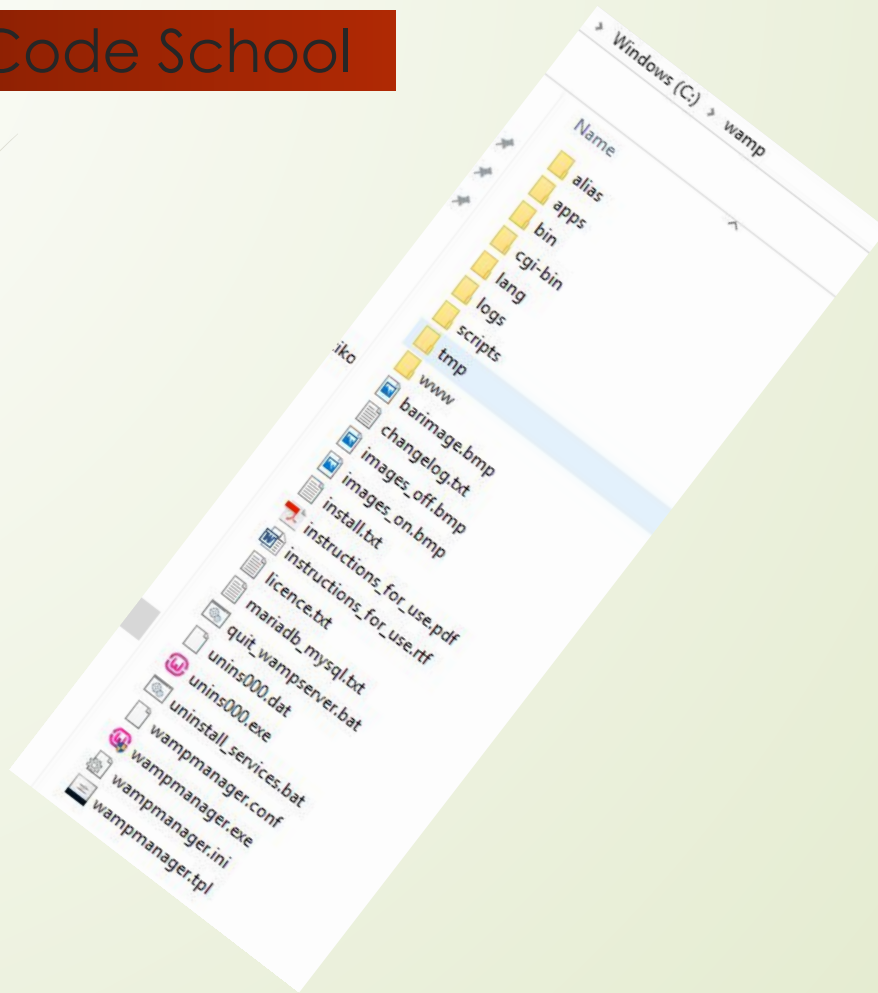
WAMP
Cgi



This is free!

Kakelino's Code School

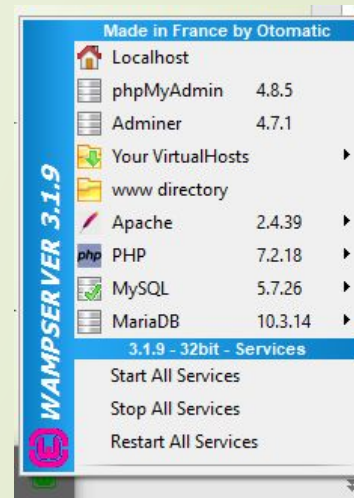
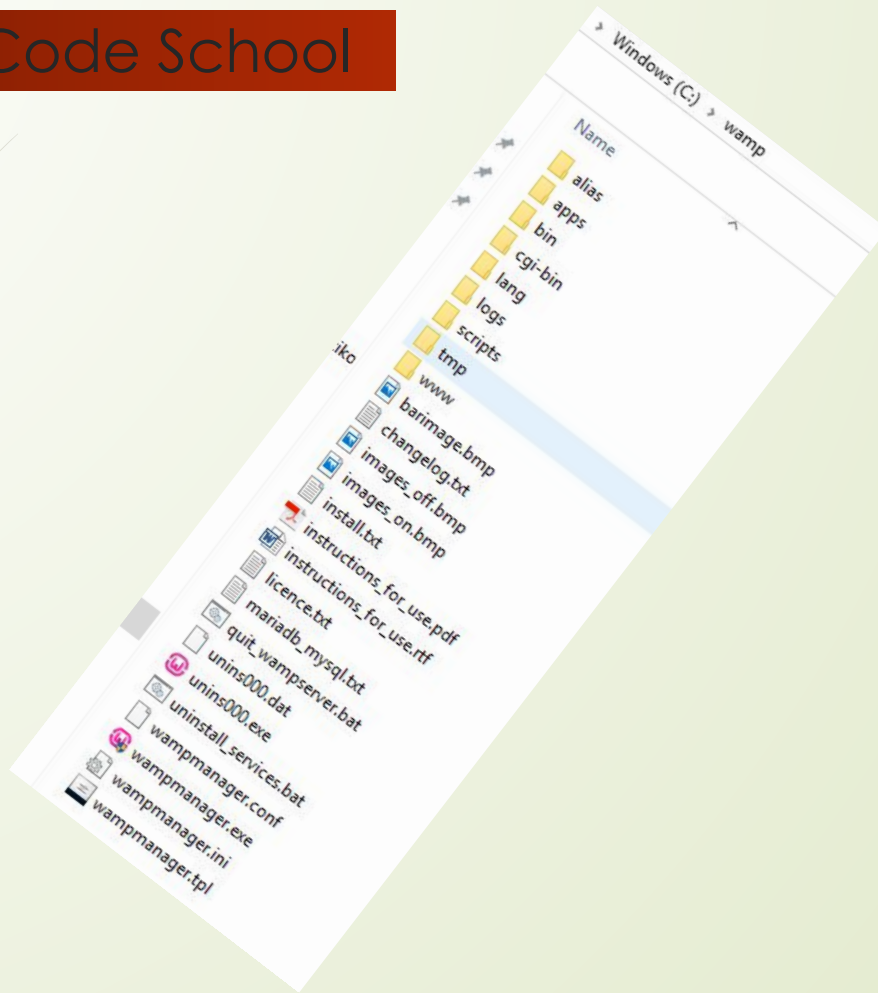
WAMP
Cgi



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WAMP
Cgi

Install and
start wamp



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WAMP
Cgi

CGI-BIN
folder
Is here



Windows (C:) > wamp > bin > apache > apache2.4.39

Name	Date modified
bin	10.1.2020 15.14
cgi-bin	10.1.2020 15.33
conf	18.11.2019 7.31
error	18.11.2019 7.31
htdocs	18.11.2019 7.31
icons	18.11.2019 7.31
include	18.11.2019 7.31
lib	18.11.2019 7.31
logs	10.1.2020 15.14
manual	18.11.2019 7.31
modules	18.11.2019 7.31

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WAMP
Cgi

CGI-BIN
folder
Is here



Windows (C:) > wamp > bin > apache > apache2.4.39

Name	Date modified
bin	10.1.2020 15:14
cgi-bin	10.1.2020 15:33
conf	18.11.2019 7:31
error	18.11.2019 7:31
htdocs	18.11.2019 7:31
icons	18.11.2019 7:31
include	18.11.2019 7:31
lib	18.11.2019 7:31
logs	10.1.2020 15:14
manual	18.11.2019 7:31
modules	18.11.2019 7:31

Some test files there

Windows (C:) > wamp > bin > apache > apache2.4.39 > cgi-bin

Name	Date modified
amount.txt	10.1.2020 15:33
printenv.pl	10.1.2020 9:08
visitors.c	10.1.2020 15:32
visitors.exe	10.1.2020 15:32

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WAMP
Cgi

We are going to
create a cgi file using
c language.

visitors.c

```
1  #include <stdio.h>
2  #include <stdlib.h>
3
4  int main()
5  {
6      FILE *file;
7      char row[10];
8      char filename[] = "amount.txt";
9      file = fopen(filename, "r");
10
11     fgets(row, 200, file);
12     int to_number = atoi(row);
13     fclose(file);
14
15     to_number++;
16     FILE *file_for_writing;
17     file_for_writing = fopen(filename, "w");
18     fprintf(file_for_writing, "%d", to_number);
19     fclose(file_for_writing);
20
21     printf("Content-type: text/html\n\n");
22     printf("<html><body>HELLO Visitor <br>");
23     printf("You are visitor number %d", to_number);
24     printf(" <br></body></html>");
```

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WAMP
Cgi

```
visitors.c
1  #include <stdio.h>
2  #include <stdlib.h>
3
4  int main()
5  {
6      FILE *file;
7      char row[10];
8      char filename[] = "amount.txt";
9      file = fopen(filename, "r");
10
11      fgets(row, 200, file);
12      int to_number = atoi(row);
13      fclose(file);
14
15      to_number++;
16      FILE *file_for_writing;
17      file_for_writing = fopen(filename, "w");
18      fprintf(file_for_writing, "%d", to_number);
19      fclose(file_for_writing);
20
21      printf("Content-type: text/html\n\n");
22      printf("<html><body>HELLO Visitor <br>");
23      printf("You are visitor number %d", to_number);
24      printf(" <br></body></html>");
```

CGI while opens a textfile that contains amount of current visitors. Amount is incremented and shown on the page

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WAMP Cgi

CGI while opens a
textfile that contains
amount of current
visitors.
Amount is incremented
and shown on the page

Test run on Windows PC

```
visitors.c
1 #include <stdio.h>
2 #include <stdlib.h>
3
4 int main()
5 {
6     FILE *file;
7     char row[10];
8     char filename[] = "amount.txt";
9     file = fopen(filename, "r");
10
11     fgets(row, 200, file);
12     int to_number = atoi(row);
13     fclose(file);
14
15     to_number++;
16     FILE *file_for_writing;
17     file_for_writing = fopen(filename, "w");
18     fprintf(file_for_writing, "%d", to_number);
19     fclose(file_for_writing);
20
21     printf("Content-type: text/html\n\n");
22     printf("<html><body>HELLO Visitor <br>");
23     printf("You are visitor number %d", to_number);
24     printf("<br></body></html>");
}
```

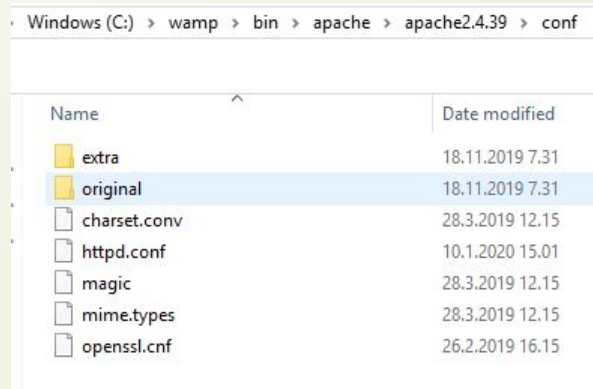
```
C:\wamp\bin\apache\apache2.4.39\cgi-bin\visitors.exe
Content-type: text/html

<html><body>HELLO Visitor <br>You are visitor number 11 <br></body></html>
-----
Process exited after 1.059 seconds with return value 19
Press any key to continue . . .
```

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WAMP
Cgi

Now we open
httpd.conf





Kakelino's Code School

WAMP
Cgi

Now we open
httpd.conf

Test if you have to
change this setting:

```
ScriptAlias /cgi-bin/ "${SRVROOT}/cgi-bin/"
```



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WAMP
Cgi

Now we open
httpd.conf

AND this:

```
AddHandler cgi-script .cgi .pl
```

Note: WAMP has not perl as default
so we can cheating a bit apache
and rename our .exe to .cgi

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WAMP Cgi

Note: WAMP has not perl as default
so we can cheating a bit apache
and rename our .exe to .cgi

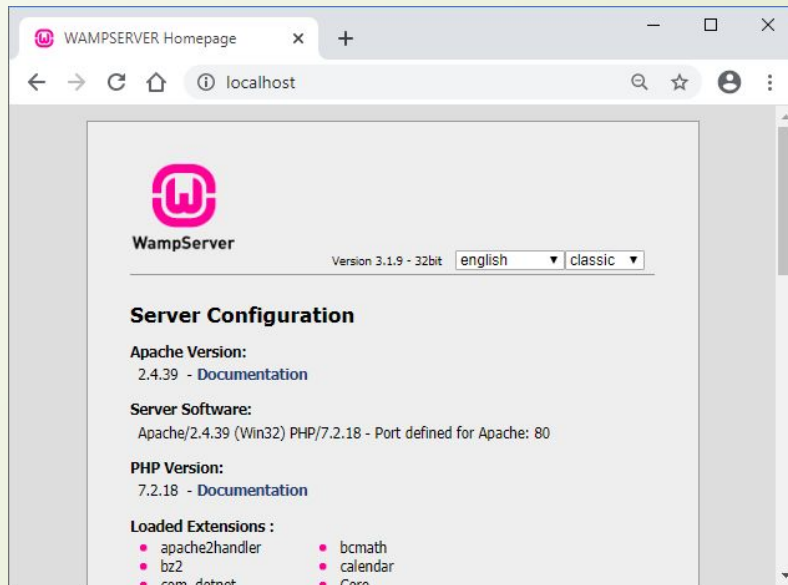
Windows (C:) > wamp > bin > apache > apache2.4.39 > cgi-bin

Name	Date modified	Type
amount.txt	10.1.2020 15:43	Text Document
printenv.pl	10.1.2020 9:08	PL File
visitors.c	10.1.2020 15:41	C Source File
visitors.exe	10.1.2020 15:43	Application

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WAMP
Cgi

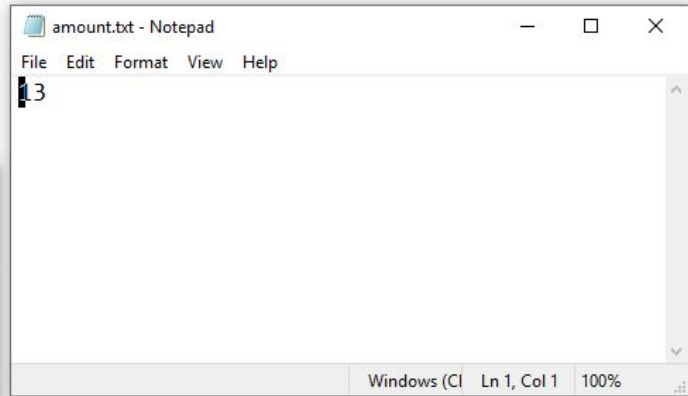
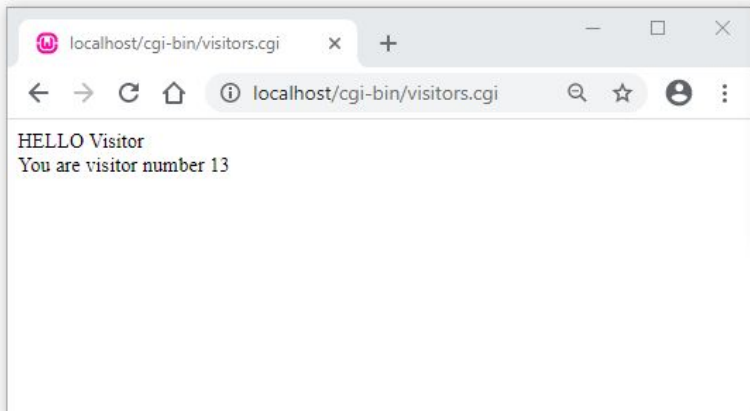
Test run 1:



Kakelino's Code School

WAMP
Cgi

Test run 2:





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WAMP
Cgi

Now you can try to do different things with CGI!

Try e.g. print out server variables and so on...

OR if you like, install perl ..

Good luck!

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Give feedback, please!
Give ideas, proposals for new
guides!

JavaScript

PHP

C

C#

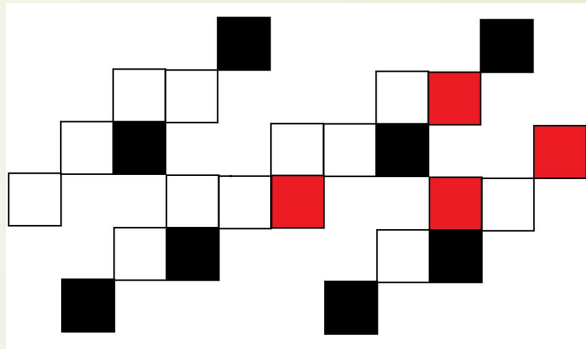
C++

Java

Python

Kakelino's Code School

WAMP
Cgi



This is free!

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WAMP
Cgi

CGI-BIN
folder
Is here



Windows (C:) > wamp > bin > apache > apache2.4.39

Name	Date modified
bin	10.1.2020 15.14
cgi-bin	10.1.2020 15.33
conf	18.11.2019 7.31
error	18.11.2019 7.31
htdocs	18.11.2019 7.31
icons	18.11.2019 7.31
include	18.11.2019 7.31
lib	18.11.2019 7.31
logs	10.1.2020 15.14
manual	18.11.2019 7.31
modules	18.11.2019 7.31

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WAMP
Cgi

Example

```
printf("Content-type: text/html\n\n");
printf("<html><body>Some CGI variables: \n");
printf("<br>");
char * info1 = getenv("SCRIPT_NAME");
printf("Script name is %s \n", info1);
printf("<br>");

char * info2 = getenv("SERVER_NAME");
printf("Server name is %s \n", info2);
printf("<br>");

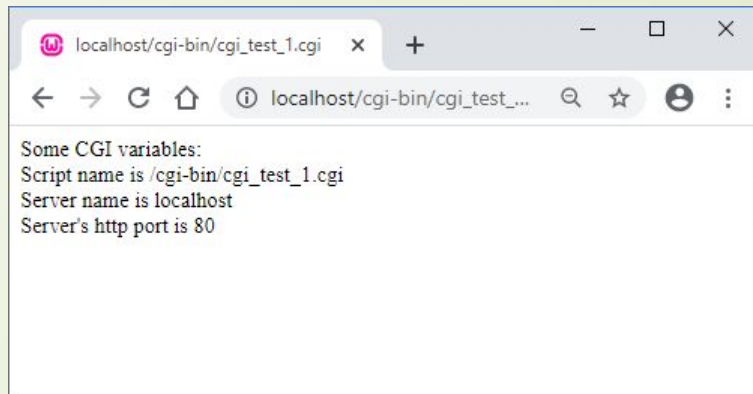
char * info3 = getenv("SERVER_PORT");
printf("Server's http port is %s \n", info3);
```

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WAMP
Cgi

Example

```
printf("Content-type: text/html\n\n");  
printf("<html><body>Some CGI variables: \n");  
printf("<br>");  
char * info1 = getenv("SCRIPT_NAME");  
printf("Script name is %s \n", info1);  
printf("<br>");  
  
char * info2 = getenv("SERVER_NAME");  
printf("Server name is %s \n", info2);  
printf("<br>");  
  
char * info3 = getenv("SERVER_PORT");  
printf("Server's http port is %s \n", info3);
```



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WAMP
Cgi

Example 2

Our cgi program catches user's information from html form.

```
printf("Content-type: text/html\n\n");  
printf("<html><body>Some CGI variables: \n");  
printf("<br>");  
char * info1 = getenv("REQUEST_METHOD");  
printf("Script name is %s \n", info1);  
printf("<br>");  
  
char * info2 = getenv("QUERY_STRING");  
printf("This info was given: %s \n", info2);
```

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WAMP
Cgi

Example 2

Our cgi program catches user's information from html form.

```
printf("Content-type: text/html\n\n");
printf("<html><body>Some CGI variables: \n");
printf("<br>");
char * info1 = getenv("REQUEST_METHOD");
printf("Script name is %s \n", info1);
printf("<br>");

char * info2 = getenv("QUERY_STRING");
printf("This info was given: %s \n", info2);
```

Html form:

```
<html>

<body>
<form name="data" method="get" action="http://localhost/cgi-bin/cgi_test_2.cgi">

Your name: <br>
<input type="Text" name="name" size=20> <br>

<input type="Submit" name="name" value="Send"> <br>

</form>

</body>

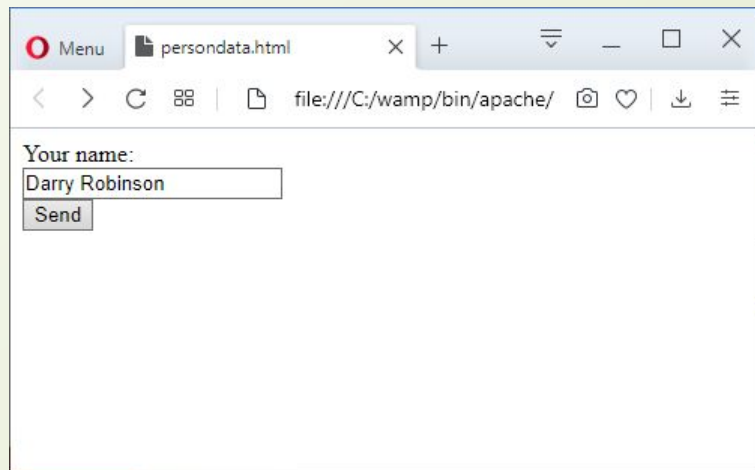
</html>
```

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WAMP
Cgi

Example 2

Our cgi program catches user's
information from html form.



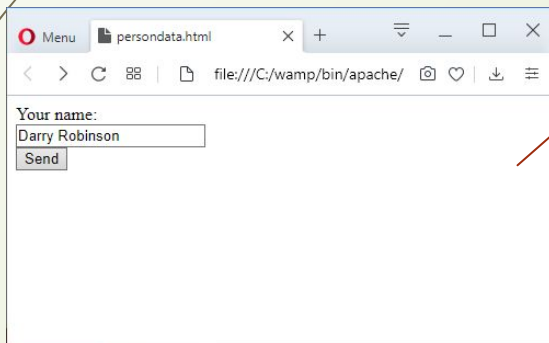
The screenshot shows a web browser window with a single tab titled 'persondata.html'. The address bar displays the file path 'file:///C:/wamp/bin/apache/'. The main content area of the browser contains a form with the label 'Your name:' followed by a text input field containing the text 'Darry Robinson'. Below the input field is a button labeled 'Send'.

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WAMP
Cgi

Example 2

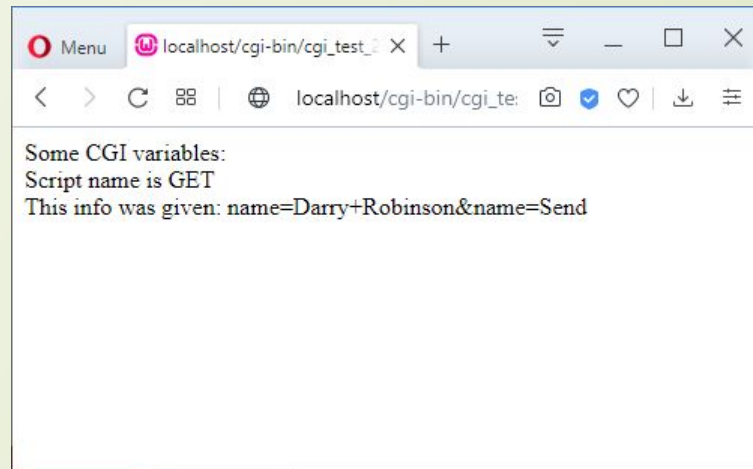
Our cgi program catches user's
information from html form.



Menu persondata.html

< > C 88 | file:///C:/wamp/bin/apache/

Your name:
Darry Robinson
Send



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WAMP
Cgi

Try it!

Add also POST method with!

Note: Examples are to be used only
In local servers – mainly for training!

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Give feedback, please!
Give ideas, proposals for new
guides!

JavaScript

PHP

C

C#

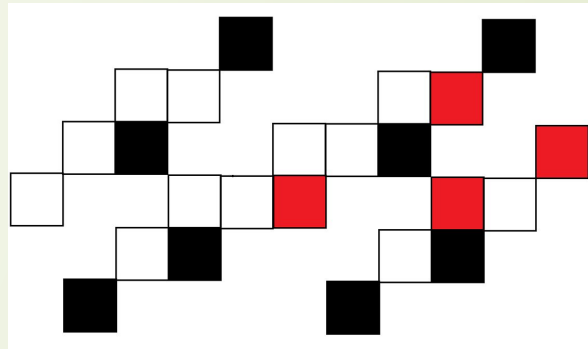
C++

Java

Python

Kakelino's Code School

UBUNTU



This is free!



```

##          ##          #          #          ##
#  #  #  #          #  #          #  #          #
    ##  #          #  #          #  #          #
    #          #          #          #          #
    #          #          #          #          #
    #          #####          #          #
    #          #####          #          #
    ##          #####          ##          ##

```

```
darry@ubuntu:~$
```



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UBUNTU

```
darry@ubuntu:~$ banner "~( ^ . ^ )" | mail darry
darry@ubuntu:~$ mail
"/var/mail/darry": 1 viesti 1 uusi
>N 1 Darry Robinson Mon Jan 13 11:35 19/939
?
Return-Path: <darry@ubuntu>
X-Original-To: darry@ubuntu
Delivered-To: darry@ubuntu
Received: by ubuntu.localdomain (Postfix, from userid 1000)
        id 2E88A81AA2; Mon, 13 Jan 2020 11:35:48 -0800 (PST)
To: <darry@ubuntu>
X-Mailer: mail (GNU Mailutils 3.4)
Message-Id: <20200113193548.2E88A81AA2@ubuntu.localdomain>
Date: Mon, 13 Jan 2020 11:35:48 -0800 (PST)
From: Darry Robinson <darry@ubuntu>
```

```
##          ##          #          #          ##
#  #  #  #          #  #          #  #          #
    ##  #          #  #          #  #          #
        #          #          #          #          #
        #          #####          #
        #          ###          #
        ##         ###          ##
? █
```



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UBUNTU

```
darry@ubuntu:~$ snap info httpd
```

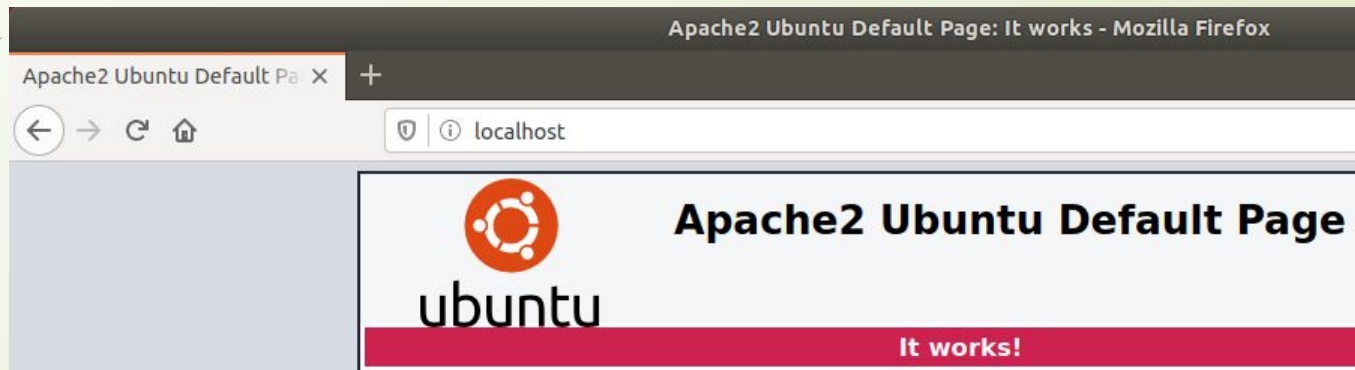
```
darry@ubuntu:~$ sudo apt install apache2
```

```
darry@ubuntu:~$ ps -aef | grep "httpd"  
darry      9157   7416   0 11:58 pts/0    00:00:00 grep --color=auto httpd
```

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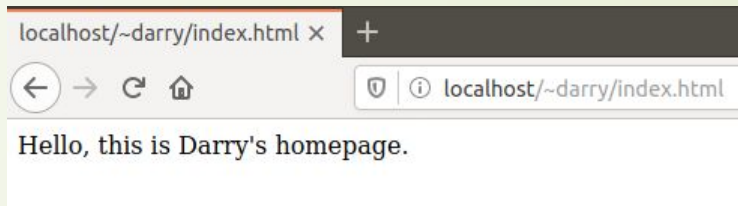
UBUNTU

```
darry@ubuntu:~$ ps -aef | grep "httpd"
darry      9157   7416   0 11:58 pts/0    00:00:00 grep --color=auto httpd
```



Kakelino's Code School

UBUNTU



```
darry@ubuntu:~$ cd public_html
darry@ubuntu:~/public_html$ ls
index.html
darry@ubuntu:~/public_html$ cat index.html
<html>

<body>

Hello, this is Darry's homepage.

</body>

</html>
```

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UBUNTU

```
darry@ubuntu:~/public_html/pass$ cat .htpasswd  
darry_grande:$apr1$t.ar4Pad$x3yuQebM5Suntzd17BgeG/  
darry@ubuntu:~/public_html/pass$
```

```
darry@ubuntu:~/public_html/secret$ ls -a  
..  .  .htaccess  index.html  
darry@ubuntu:~/public_html/secret$
```

```
darry@ubuntu:~/public_html/secret$ cat .htaccess  
AuthUserFile /home/darry/public_html/pass/.htpasswd  
AuthGroupFile /dev/null  
AuthName Login  
AuthType Basic  
<Limit GET POST>  
require user darry_grande  
</Limit>
```

Kakelino's Code School

UBUNTU

```
darry@ubuntu:~/public_html/pass$ cat .htpasswd  
darry_grande:$apr1$t.ar4Pad$x3yuQebM5Suntzd17BgeG/  
darry@ubuntu:~/public_html/pass$
```

```
darry@ubuntu:~/public_html/secret$ ls -a  
.. .htaccess index.html  
darry@ubuntu:~/public_html/secret$
```

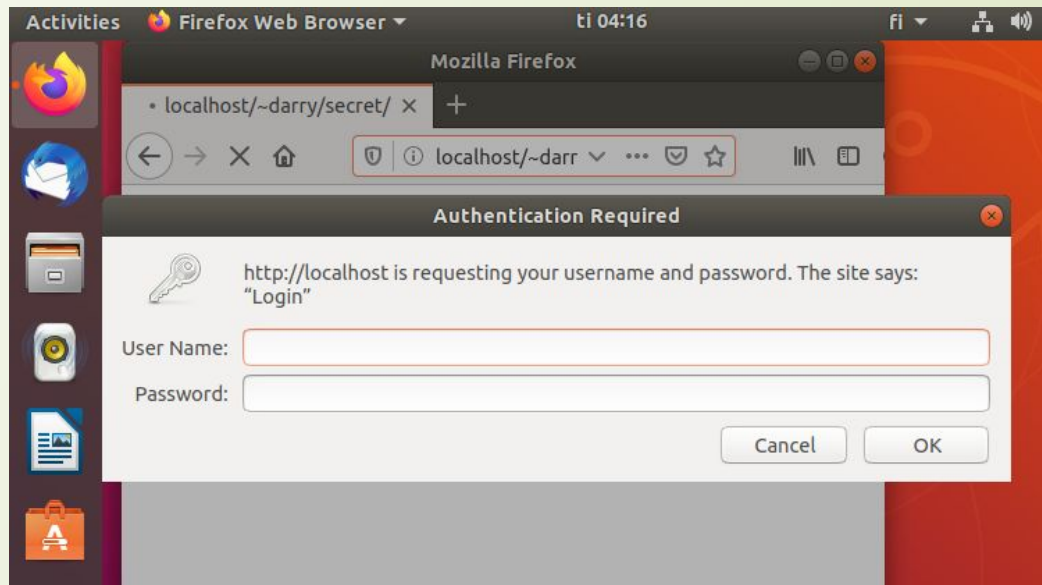
```
darry@ubuntu:~/public_html/secret$ cat .htaccess  
AuthUserFile /home/darry/public_html/pass/.htpasswd  
AuthGroupFile /dev/null  
AuthName Login  
AuthType Basic  
<Limit GET POST>  
require user darry_grande  
</Limit>
```

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UBUNTU

```
darry@ubuntu:~/public_html/pass$ cat .htpasswd  
darry_grande:$apr1$t.ar4Pad$x3yuQebM5Suntzd17BgeG/  
darry@ubuntu:~/public_html/pass$
```

```
darry@ubuntu:~/public_html/secret$ ls -a  
.  
..  
.htaccess  
index.html  
darry@ubuntu:~/public_html/secret$
```

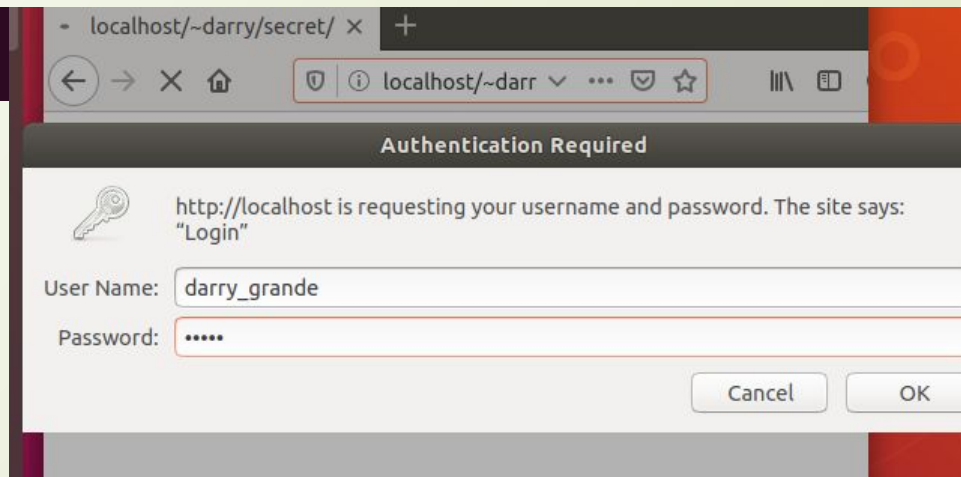


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UBUNTU

```
darry@ubuntu:~/public_html/pass$ cat .htpasswd  
darry_grande:$apr1$t.ar4Pad$x3yuQebM5Suntzd17BgeG/  
darry@ubuntu:~/public_html/pass$
```

```
darry@ubuntu:~/public_html/secret$ ls -a  
. .. .htaccess index.html  
darry@ubuntu:~/public_html/secret$
```

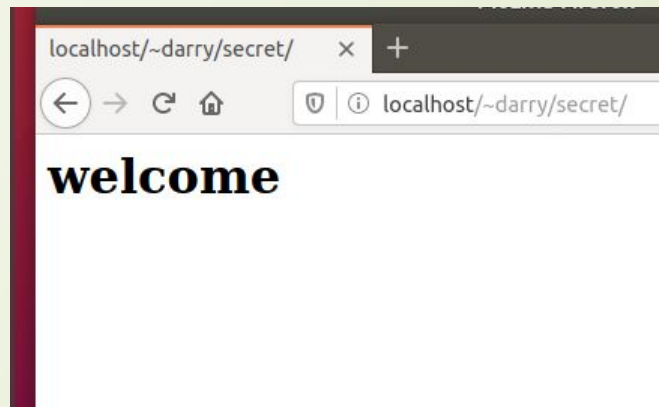


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UBUNTU

```
darry@ubuntu:~/public_html/pass$ cat .htpasswd  
darry_grande:$apr1$t.ar4Pad$x3yuQebM5Suntzd17BgeG/  
darry@ubuntu:~/public_html/pass$
```

```
darry@ubuntu:~/public_html/secret$ ls -a  
.  
..  
.htaccess  
index.html  
darry@ubuntu:~/public_html/secret$
```



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UBUNTU

```
darry@ubuntu:/var/www/cgi-bin$ ls -la
total 12
drwxrwxrwx 2 darry www-data 4096 tammi 14 03:53
drwxr-xr-x 4 root root 4096 tammi 14 03:49 ..
-rw-r--r-- 1 darry darry 15 tammi 14 03:53 a.cgi
darry@ubuntu:/var/www/cgi-bin$ chmod 755 a.cgi
darry@ubuntu:/var/www/cgi-bin$ ls -la
total 12
drwxrwxrwx 2 darry www-data 4096 tammi 14 03:53
drwxr-xr-x 4 root root 4096 tammi 14 03:49 ..
-rwxr-xr-x 1 darry darry 15 tammi 14 03:53 a.cgi
darry@ubuntu:/var/www/cgi-bin$
```

```
darry@ubuntu:/etc/apache2$ ls -la
. apache2.conf conf-enabled magic mods-enabled sites-available
.. conf-available envvars mods-available ports.conf sites-enabled
darry@ubuntu:/etc/apache2$
```

GNU nano 2.9.3 apache2.conf

```
ScriptAlias /cgi-bin/ /var/www/cgi-bin/

<Directory "/var/www/cgi-bin/">
    Options ExecCGI
    AddHandler cgi-script cgi pl
</Directory>
```



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UBUNTU

```
darry@ubuntu:/etc/apache2$ ls -la
.  apache2.conf  conf-enabled  magic  mods-enabled  sites-available
.. conf-available  envvars  mods-available  ports.conf  sites-enabled
darry@ubuntu:/etc/apache2$ sudo nano apache2.conf
[sudo] password for darry:
darry@ubuntu:/etc/apache2$ sudo /etc/init.d/apache2 restart
```

```
GNU nano 2.9.3      serve-cgi-bin.conf

<IfModule mod_alias.c>
    <IfModule mod_cgi.c>
        Define ENABLE_USR_LIB_CGI_BIN
    </IfModule>

    <IfModule mod_cgid.c>
        Define ENABLE_USR_LIB_CGI_BIN
    </IfModule>

    <IfDefine ENABLE_USR_LIB_CGI_BIN>
        ScriptAlias /cgi-bin/ /usr/lib/cgi-bin/
        <Directory "/usr/lib/cgi-bin">
            AllowOverride None
            Options +ExecCGI -MultiViews +SymLinksIfOwnerMatch
            Require all granted
        </Directory>
    </IfDefine>
</IfModule>
```



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UBUNTU

```
GNU nano 2.9.3      b.c
#include <stdio.h>

int main()
{
    printf("Content-type: text/html\n\n");
    printf("<html><body>HELLO! This is a cgi program! \n");
    printf("<br> </body> </html>");
}
```

```
darry@ubuntu:/var/www/cgi-bin$ gcc b.c -o b.cgi
```



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UBUNTU

```
GNU nano 2.9.3      b.c
#include <stdio.h>

int main()
{
    printf("Content-type: text/html\n\n");
    printf("<html><body>HELLO! This is a cgi program! \n");
    printf("<br> </body> </html>");
}
```

```
darry@ubuntu:/var/www/cgi-bin$ gcc b.c -o b.cgi
```

```
-rwxr-xr-x 1 darry darry 8344 tammi 14 05:14 b.cgi
```

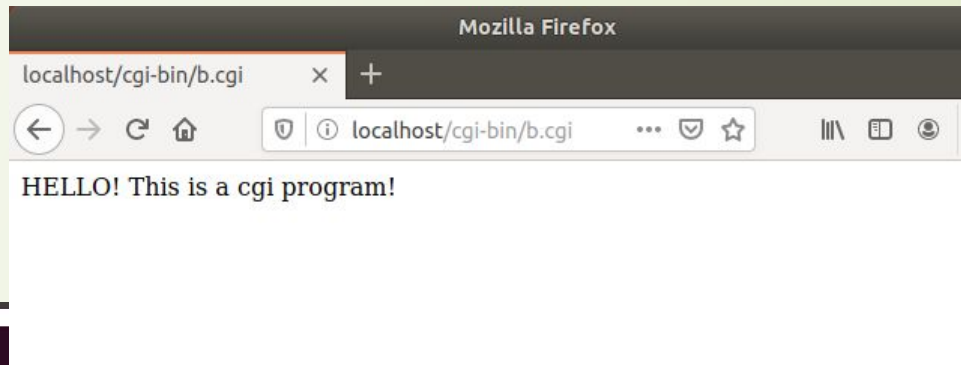
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UBUNTU



```
GNU nano 2.9.3      b.c
#include <stdio.h>

int main()
{
    printf("Content-type: text/html\n\n");
    printf("<html><body>HELLO! This is a cgi program! \n");
    printf("<br> </body> </html>");
}
```





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Try it!

Note:

Cgi-programs are not used nowadays!

But it is good to know Linux and its settings..

AND concerning REST .htaccess can still be used a bit ...

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Give feedback, please!
Give ideas, proposals for new
guides!

JavaScript

PHP

C

C#

C++

Java

Python

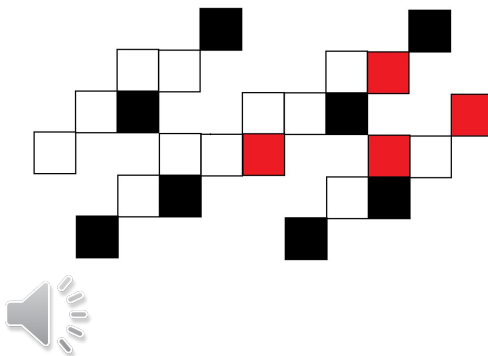
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Coding in a nutshell

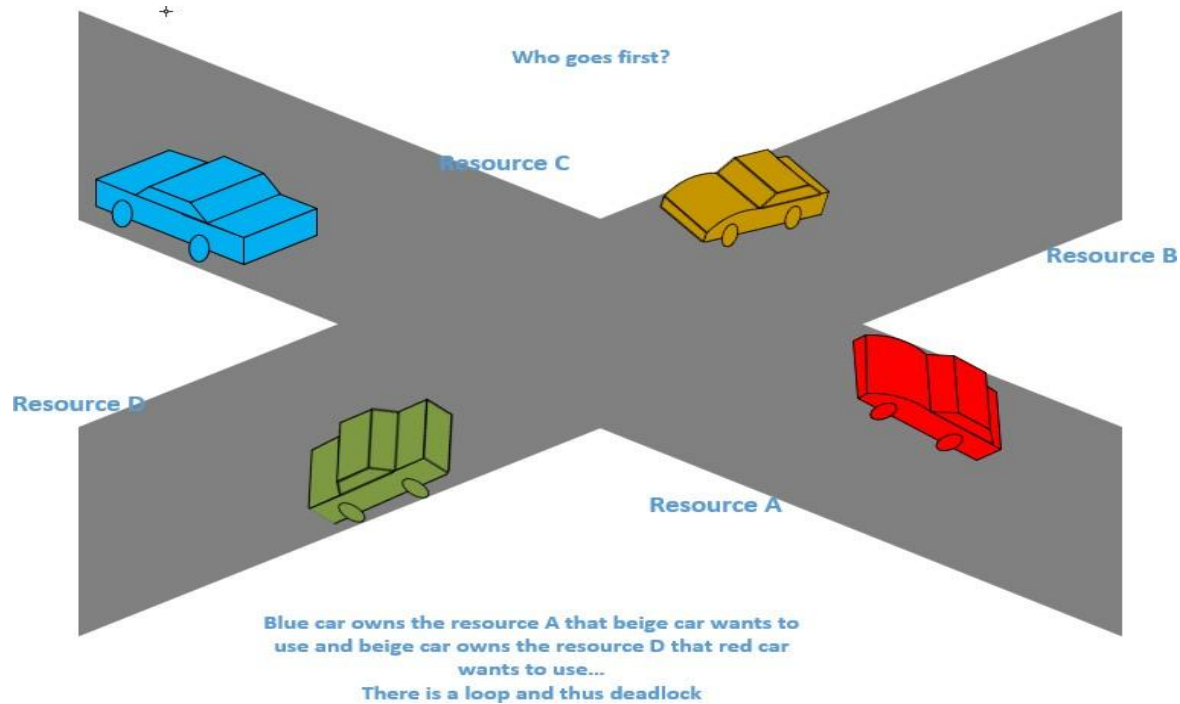
- * solving basic level problems

Operating systems: processes

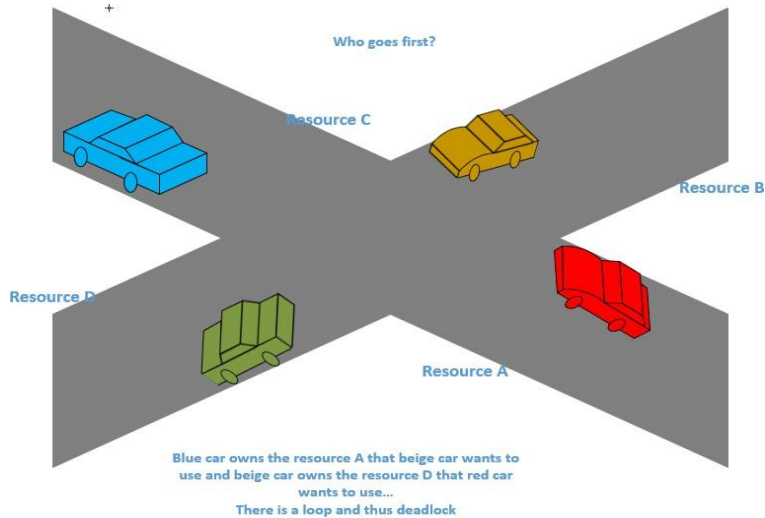
About processes and deadlock



Here we have deadlock!



Here we have deadlock!



Who could help?

May be a policeman...

May be emergency vehicle has to allowed go...

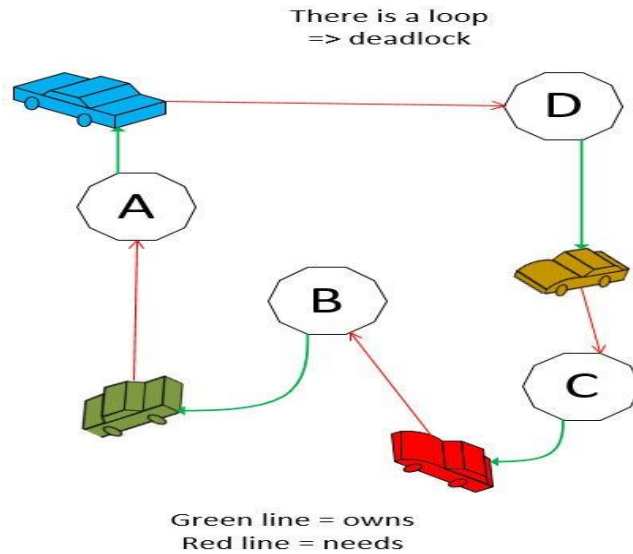
OR, may be one of drivers is so friendly that lets someone go before him...

Is OS is co-operative, that could be possible..

OR maybe starving process needs a better priority (we can make it temporarily higher)...

...

Process	Owns this resource	Needs this resource
Red car	C	B
Blue car	A	D
Beige car	D	C
Green car	B	A



Conditions for deadlock

1. Mutual exclusion
 - A resource is either assigned to 1 process or available
 2. Hold and wait condition
 - Possible to own one resource while claiming another
 3. No preemption condition
 - granted resources cannot taken away by force
 4. Circular wait condition
 - Each waiting process is waiting for the next in the chain
- All four conditions must be met in order for a deadlock to occur

Source:

<https://www.mdh.se/international>

How to avoid this?

The ostrich algorithm

The easiest way to deal with the problem:

Stick your head in the sand and pretend that there is no problem

Many resources of each type

Checking deadlock (example)

Here are vectors and matrixes that we can now use

$$E = [e_1 \quad e_2 \quad \dots \quad e_n]$$

A vector of **existing** resources of type e_x

$$A = [a_1 \quad a_2 \quad \dots \quad a_n]$$

A vector of **available** resources of type a_x

$$C = \begin{bmatrix} c_{11} & c_{12} & \dots & c_{1n} \\ c_{21} & c_{22} & \dots & c_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ c_{m1} & c_{m1} & \dots & c_{mn} \end{bmatrix}$$

A matrix containing the # of resources of Type n **claimed** by process m .

$$R = \begin{bmatrix} r_{11} & r_{12} & \dots & r_{1n} \\ r_{21} & r_{22} & \dots & r_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ r_{m1} & r_{m1} & \dots & r_{mn} \end{bmatrix}$$

A matrix containing the # of resources of Type n **requested** by process m .

We see that:

$$\sum_{i=1}^m c_{ij} + a_j = e_j$$

Vectors E

Existing resources A

Available resources C

Resources claimed by process D

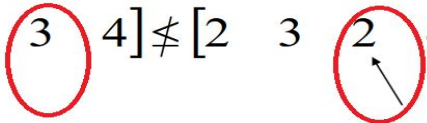
Resources requested by process

Checking deadlock Main checking principle

For two vectors, X and Y

$$X \leq Y \text{ iff } x_i \leq y_i \text{ for } 0 \leq i \leq m$$

For example:

$$\begin{array}{cccc} [1 & 2 & 3 & 4] \leq [2 & 3 & 4 & 4] \\ [1 & 2 & 3 & 4] \not\leq [2 & 3 & 2 & 4] \end{array}$$


Example from

<https://www.mdh.se/international>

$E = \{4\ 2\ 3\ 1\}$

$A = \{2\ 1\ 0\ 0\}$ C

=

P1	0	0	1	0
P2	2	0	0	1
P3	0	1	2	0

R =

P1	2	0	0	1
P2	1	0	1	0
P3	2	1	0	0

E Existing resources

A Available resources

C Resources claimed by process

D Resources requested by process

P3

$$R \leq A$$

$$2,1,0,0 \leq 2,1,0,0$$

⇒ finish and free resources

$$A \text{ is then } A + C = 2,1,0,0 + 0,1,2,0 = 2,2,2,0$$

P2

$$R \leq A$$

$$1,0,1,0 \leq 2,2,2,0$$

⇒ finish and free resources

$$A \text{ is then } A + C = 2,2,2,0 + 2,0,0,1 = 4,2,2,1$$

P1

$$R \leq A$$

$$2,0,0,1 \leq 4,2,2,1$$

⇒ finish and free resources

$$A \text{ is then } A + C = 4,2,2,1 + 0,0,1,0 = 4,2,3,1$$

SO, no deadlock...

Example from

<https://www.geeksforgeeks.org/deadlock-detection-algorithm-in-operating-system/>

	Allocated	Requested	Available
Process	A B C	A B C	A B C
P0	0 1 0	0 0 0	0 0 0
P1	2 0 0	2 0 2	
P2	3 0 3	0 0 0	
P3	2 1 1	1 0 0	
P4	0 0 2	0 0 2	

C# prototype

```
static void Main(string[] args)
{
    // source
    // https://www.geeksforgeeks.org/deadlock-detection-algorithm-in-operating-system/
    // m, n
    // m = 3, n = 5
    int[] work = { 0, 0, 0 };    // Available, A, B, C
    bool[] finish = { false, false, false, false, false};

    int i = 0;    // process P0
    int[] allocation = { 0, 1, 0 };
    int[] request = { 0, 0, 0 };
    if (request[0] <= work[0] && request[1] <= work[1] &&
        request[2] <= work[2])
        finish[0] = true; if
    (finish[0] == true)
    {
        work[0] = request[0] + work[0];
        work[1] = request[1] + work[1];
        work[2] = request[2] + work[2];
    }
    i = 2;    // process P2
    // work = {0,1,0};
    // allocation = { 3, 0, 3 };
    // request = { 0, 0, 0 };
    if (request[0] <= work[0] && request[1] <= work[1] &&
        request[2] <= work[2])
        finish[2] = true; if
```

```

}
// work = {3, 1, 3};  i
= 1;    // process P1
        // allocation = { 2, 0 ,0 };
        // request = { 2, 0, 2 };
if (request[0] <= work[0] && request[1] <= work[1]
    && request[2] <= work[2])
    finish[1] = true;
if (finish[1] == true)
{
    work[0] = request[0] + work[0];
    work[1] = request[1] + work[1];
    work[2] = request[2] + work[2];
}
// work = {5, 1, 3};

i = 3; // process P3
        // allocation = { 2, 1 ,1 };
        // request = { 1, 0, 0 };
if (request[0] <= work[0] && request[1] <= work[1]
    && request[2] <= work[2])
    finish[3] = true;
if (finish[3] == true)
{
    work[0] = request[0] + work[0];
    work[1] = request[1] + work[1];
    work[2] = request[2] + work[2];
}
// work = {7, 2, 4};

i = 4; // process P4

```

```
if (finish[4] == true)
{
    work[0] = request[0] + work[0];
    work[1] = request[1] + work[1];
    work[2] = request[2] + work[2];
}
// work = {7, 2, 6};
// processes are finished => no deadlock
}
```

The prototype is to be developed...

Here is a better version that check first if there are any processes that can be finished...

Part 1

```
static void checkDeadlock()
{
    int amount_of_processes = 5;
    int amount_of_resources = 3;
    int[] available = { 0, 0, 0 }; // Available, A, B, C
    int[] allocation = { 0, 1, 0 }; // current allocation
    int[] request = { 0, 0, 0 }; // need
    // here we combine allocation and request values to one matrix
    int[,] all =
    {
        { 0,0,0,0,1,0 },
        { 2,0,2,2,0,0 },
        { 0,0,0,3,0,3 },
        { 1,0,0,2,1,1 },
        { 0,0,2,0,0,2 } };

    bool[] finish = { false, false, false, false, false };

    int[] current_possible_processes = { 1,1,1,1,1 };
    for (int k = 0; k < amount_of_processes; k++)
    {
        for (int j = 0; j < amount_of_resources; j++)
        {
            if (all[k,j] > available[j] )
            {
                current_possible_processes[k] = -1;
                break;
            }
        }
    }
}
```

Part 2

```
// here we get to know, which processes can be finished and thus
// they can release their resources

for (int k = 0; k < amount_of_processes; k++)
    Console.Write(" " + current_possible_processes[k]);

// releasing resources
for (int k = 0; k < amount_of_processes; k++)
{
    if (current_possible_processes[k] == 1)
    {
        for (int j = 0; j < amount_of_resources; j++)
        {
            available[j] += all[k, j + 3];
        }
        finish[k] = true;
    }
}

Console.WriteLine();

for (int j = 0; j < amount_of_resources; j++)
    current_possible_processes[j] = 1;

for (int k = 0; k < amount_of_processes; k++)
    Console.Write(" " + finish[k]);

for (int k = 0; k < amount_of_processes; k++)
{
    if (finish[k] == false)
        for (int j = 0; j < amount_of_resources; j++)
        {
            if (all[k, j] > available[j])
            {
                current_possible_processes[k] = -1;
                break;
            }
        }
}
}
```

Part 3

```
for (int k = 0; k < amount_of_processes; k++)
    Console.Write(" " + current_possible_processes[k]);

Console.WriteLine();

for (int k = 0; k < amount_of_processes; k++)
    Console.Write(" " + finish[k]);

for (int k = 0; k < amount_of_processes; k++)
{
    if (current_possible_processes[k] == 1 && finish[k] == false)
    {
        for (int j = 0; j < amount_of_resources; j++)
        {
            available[j] += all[k, j + 3];
        }
        finish[k] = true;
    }
}

for (int j = 0; j < amount_of_resources; j++)
    Console.Write(" " + available[j]);
// p3, p4 remaining
Console.WriteLine();
for (int j = 0; j < amount_of_processes; j++)
    current_possible_processes[j] = 1;

Console.WriteLine("\nprocess values");

for (int k = 0; k < amount_of_processes; k++)
    Console.Write(" " + current_possible_processes[k]);

Console.WriteLine("States");

for (int k = 0; k < amount_of_processes; k++)
    Console.Write(" " + finish[k]);
```

Part 4

```
Console.WriteLine("\n values");
for (int k = 0; k < amount_of_processes; k++)
{
    if (finish[k] == false)
        for (int j = 0; j < amount_of_resources; j++)
        {
            if (all[k, j] > available[j])
            {
                Console.Write(" " + all[k, j] + " " + available[j] + "\n");
                current_possible_processes[k] = -1;
                break;
            }
        }
}
Console.WriteLine("\nprocess values");

for (int k = 0; k < amount_of_processes; k++)
    Console.Write(" " + current_possible_processes[k]);
Console.WriteLine();

for (int k = 0; k < amount_of_processes; k++)
    Console.Write(" " + finish[k]);

for (int k = 0; k < amount_of_processes; k++)
{
    if (current_possible_processes[k] == 1 && finish[k] == false)
    {
        for (int j = 0; j < amount_of_resources; j++)
        {
            available[j] += all[k, j + 3];
        }
        finish[k] = true;
    }
}
```

Test run

```
7 2 6  
True True True True True
```

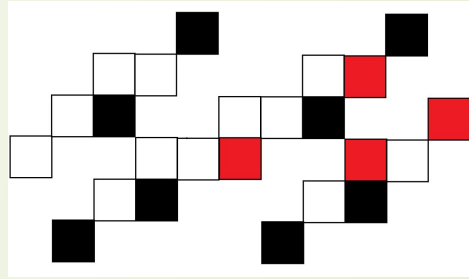
So, we got the same results than i manual simulation
and prototype...

Still, we need a more universal version...

Thank you!!

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About RTOS



This is
free!



RTOS (RealTime Operating System)

Example microC os

Summary

References

MicroC/OS-II: The Real Time Kernel by Jean J.
Labrosse



Critical sessions

Critical sessions (no interrupts allowed)

```
#define OS_ENTER_CRITICAL() asm CLI
```

```
#define OS_EXIT_CRITICAL() asm STI
```

Example of task

```
void far Task(void *data)
```

```
{
```

```
    UBYTE x;
```

```
    UBYTE y;
```

```
    UBYTE err; while
```

```
    (1) {
```

```
        OSTimeDly(1);    /* Delay 1 clock tick          */ OSemPend(RandomSem, 0, &err); /*
```

```
        Acquire semaphore to perform random numbers      */
```

```
        x = random(79); /* Find X position where task number will appear */
```

```
        y = random(21); /* Find Y position where task number will appear */
```

```
        OSemPost(RandomSem); /* Release semaphore      */
```

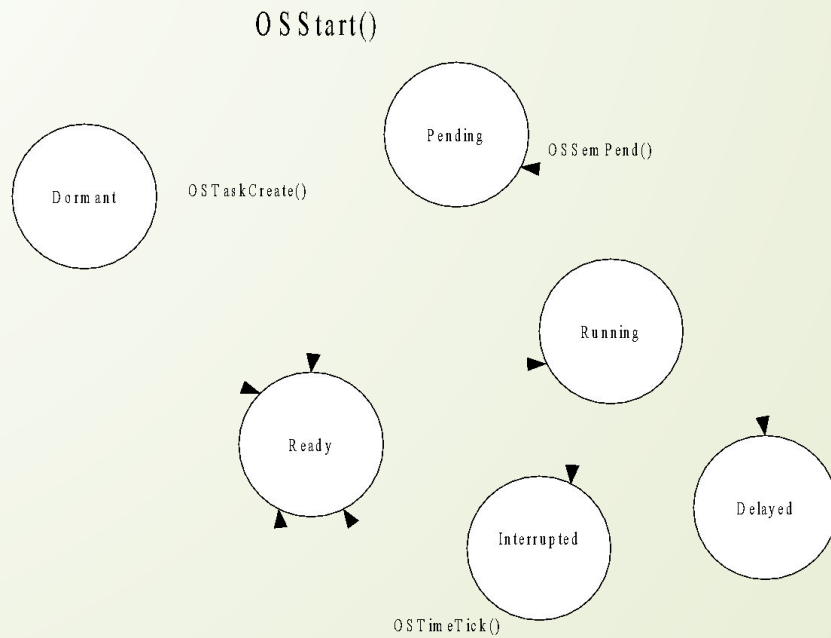
```
        DispChar(x, y, *(char *)data); /* Display the task number on the screen */
```

```
    }
```

```
}
```



Task states





Example of task control block

```

/*
*****
*
*          uC/OS TASK CONTROL BLOCK
***** */
typedef struct os_tcb {
    void OS_FAR *OSTCBStkPtr; /* Pointer to current top of stack */
    UBYTE OSTCBStat; /* Task status: 0 = ready to run */
    UBYTE OSTCBPrio; /* Task priority (0 == highest, 63 == lowest) */
    UWORD OSTCBDly; /* Nbr ticks to delay task or, timeout waiting for event */
    BOOLEAN OSTCBDeReq; /* Indicates whether a task needs to delete itself */
    UBYTE OSTCBX; /* Bit position in group corresponding to task priority (0..7) */
    UBYTE OSTCBY; /* Index into ready table corresponding to task priority */
    UBYTE OSTCBBitX; /* Bit mask to access bit position in ready table */
    UBYTE OSTCBBitY; /* Bit mask to access bit position in ready group */
    OS_EVENT *OSTCBEvtPtr; /* Pointer to event control block */
    void *OSTCBMsg; /* Message received from OSMboxPost() or OSQPost() */
    struct os_tcb *OSTCBNext; /* Pointer to next TCB in the TCB list */
    struct os_tcb *OSTCBPrev; /* Pointer to previous TCB in the TCB list */
} OS_TCB;

```

Note these fields:

```

UBYTE OSTCBX; /* Bit position in group corresponding to task priority (0..7) */
UBYTE OSTCBY; /* Index into ready table corresponding to task priority */
UBYTE OSTCBBitX; /* Bit mask to access bit position in ready table */
UBYTE OSTCBBitY; /* Bit mask to access bit position in ready group */

```

TCB is created when a new task is created. TCB is added to queue.



How to decide which task is to be executed by the processor?

OSSched() makes the decision.

It is executed in a critical session.

```
void OSSched(void)
{
    UBYTE y;
    OS_ENTER_CRITICAL();
    if ((OSLockNesting | OSIntNesting) == 0)
    {
        /* Task scheduling must be enabled and not ISR level */
        y = OSUnMapTbl[OSRdyGrp];
        /* Get pointer to highest priority task ready to run */
        OSTCBHighRdy = OSTCBPrioTbl[(y << 3) + OSUnMapTbl[OSRdyTbl[y]]];
        if (OSTCBHighRdy != OSTCBCur)
        {
            /* Make sure this is not the current task running */
            OSCTxSwCtr++; /* Increment context switch counter */
            OS_TASK_SW(); /* Perform a context switch */
        }
    }
    OS_EXIT_CRITICAL();
}
```



It is very important code. SO let's take a look at it.

First, how to add new task to ready-list (to the list that tell which task is to be executed next):

Tasks are grouped. There are 8 tasks in each group.

First info (tells if some task in that group is ready to be executed) is in the variable called

OSRdyGrp

If some task in that group is ready, sets group bit to 1.



Then, correspondent bit is set on in table:

OSRdyTbl[8].

Here is the table (value refers to task id (now also task priority):

OSRdyTbl[8]							
x							
7	6	5	4	3	2	1	0
15	14	13	12	11	10	9	8
23	22	21	20	19	18	17	16
31	30	29	28	27	26	25	24
39	38	37	36	35	34	33	32
47	46	45	44	43	42	41	40
55	54	53	52	51	50	49	48
63	62	61	60	59	58	57	56



Here is the code that add new task to **ready list** (code is part of function `OSSched()`):

```
OSRdyTbl[p >> 3] |= OSMaTbl[p & 0x07];  
OSRdyGrp |= OSMaTbl[p >> 3];
```

In masking OS uses a ROM table called OSMaTbl[8].

Table is used when adding a new task to ready list.

Indeksi	Bittimaski
0	0000 0001
1	0000 0010
2	0000 0100
3	0000 1000
4	0001 0000
5	0010 0000
6	0100 0000
7	1000 0000



Let's simulate that procedure!

Task id could be 20 (is a priority, too).

We have this code (taken from scheduling function): `OSRdyGrp |= OSMaTbl[p >> 3];`

`OSRdyTbl[p >> 3] |= OSMaTbl[p & 0x07];`

Our task is the first one now.

`OSRdyGrp = OSRdyGrp | OSMaTbl[p >> 3];`

0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---

`OSRdyGrp` is 0, because there are no tasks...

Let's handle now this

`OSMaTbl[p >> 3];`



ID and p is 20 (we decided that earlier). 20 in

binary format is 00010100

We shift that queue to the right 3 times and get 00000010 (that is 2). SO,

we refer to OSMapTbl[2]

In that position we have 0000 0100

Indeksi	Bittimaski
0	0000 0001
1	0000 0010
2	0000 0100
3	0000 1000
4	0001 0000
5	0010 0000
6	0100 0000
7	1000 0000

SO,

OSRdyGrp = 00000000 | 00000100

00000000

00000100

00000100 (OR, |)

OSRdyGrp (result)



Thus $\text{OSRdyGrp} = 00000100$

Then we have to update **OSRdyTbl**

`OSRdyTbl[p >> 3] |= OSMaTbl[p & 0x07];`

P >> 3 was 00000010 (2) (from previous code). AND then

`OSMaTbl[p & 0x07]` First: what is p & 0x07 P is 2 =

00000010

0x07 is in hexadecimal format

In decimal format is it 7 and in binary format 00000111.

So p & 0x07 is 00000010

00000111 (AND; &)

00000010 => 2

AND we get from `OSMaTbl[]`: `OSMaTbl[2] = 0000 0100`



SO, we get

```
OSRdyTbl[p >> 3] |= OSMaTbl[p & 0x07];
```

```
OSRdyTbl[2] = OSRdyTbl[2] | OSMaTbl[2];
```

OSRdyTbl[2] is

00000000

00000100 (|)

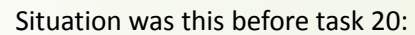
00000100

SO, 00000100 is OSRdyTbl[2]

Result is shown in this table:

7	6	5	4	3	2	1	0
15	14	13	12	11	10	9	8
23	22	21	20	19	18	17	16
31	30	29	28	27	26	25	24
39	38	37	36	35	34	33	32
47	46	45	44	43	42	41	40
55	54	53	52	51	50	49	48
63	62	61	60	59	58	57	56

OSRdyTbl[8] (now table shows task ids (priorities):

[illegible]



AND

OSRdyTbl[2] is 00000100

0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	1	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0

Good, we have added a new task to ready-list and updated correspondent data structures.



May be task is to be executed by the processor and we have to remove in from readylist and update data structures.

Code is

```
if ((OSRdyTbl [p>>3] &= ~ OSMaTbl[p & 0x07]) == 0);
```

```
OSRdyGrp &= ~OSMaTbl[p >> 3];
```

OSRdyTbl [p>>3] is now 00000100 p &
0x07 is 00000010 (2)

OSMaTbl[2] = 00000100

~ OSMaTbl[2] = 11111011 SO

OSRdyTbl [2] = OSRdyTbl [2] & ~ OSMaTbl[2]

00000100

11111011 (and &)

00000000



Then we have to update

```
OSRdyGrp &= ~OSMapTbl[p >> 3];
```

OSRdyGrp is 00000100

~OSMapTbl[p >> 3] is 11111011

So we get:

OSRdyGrp = 00000100 & 11111011

00000100

11111011 (and &)

00000000

So

OSRdyGrp is now 00000000



If there are several tasks in the ready list, how to decide which task is given run time?

We use table

OSUnMapTbl[256]

We have to get the priority (now also task id) first: $y =$

$\text{OSUnMapTbl}[\text{OSRdyGrp}];$

$x = \text{OSUnMapTbl}[\text{OSRdyTbl}[y]]; p =$

$(y \ll 3) + x;$



Here is the OSUnMapTbl:

```
UBYTE const OSUnMapTbl[] = {  
    0, 0, 1, 0, 2, 0, 1, 0, 3, 0, 1, 0, 2, 0, 1, 0,  
    4, 0, 1, 0, 2, 0, 1, 0, 3, 0, 1, 0, 2, 0, 1, 0,  
    5, 0, 1, 0, 2, 0, 1, 0, 3, 0, 1, 0, 2, 0, 1, 0,  
    4, 0, 1, 0, 2, 0, 1, 0, 3, 0, 1, 0, 2, 0, 1, 0,  
    6, 0, 1, 0, 2, 0, 1, 0, 3, 0, 1, 0, 2, 0, 1, 0,  
    4, 0, 1, 0, 2, 0, 1, 0, 3, 0, 1, 0, 2, 0, 1, 0,  
    5, 0, 1, 0, 2, 0, 1, 0, 3, 0, 1, 0, 2, 0, 1, 0,  
    4, 0, 1, 0, 2, 0, 1, 0, 3, 0, 1, 0, 2, 0, 1, 0,  
    7, 0, 1, 0, 2, 0, 1, 0, 3, 0, 1, 0, 2, 0, 1, 0,  
    4, 0, 1, 0, 2, 0, 1, 0, 3, 0, 1, 0, 2, 0, 1, 0,  
    5, 0, 1, 0, 2, 0, 1, 0, 3, 0, 1, 0, 2, 0, 1, 0,  
    4, 0, 1, 0, 2, 0, 1, 0, 3, 0, 1, 0, 2, 0, 1, 0,  
    6, 0, 1, 0, 2, 0, 1, 0, 3, 0, 1, 0, 2, 0, 1, 0,  
    4, 0, 1, 0, 2, 0, 1, 0, 3, 0, 1, 0, 2, 0, 1, 0,  
    5, 0, 1, 0, 2, 0, 1, 0, 3, 0, 1, 0, 2, 0, 1, 0,  
    4, 0, 1, 0, 2, 0, 1, 0, 3, 0, 1, 0, 2, 0, 1, 0  
};
```



Let's simulate this:

```
y = OSUnMapTbl[OSRdyGrp];  
x = OSUnMapTbl[OSRdyTbl[y]];  
  
p = (y << 3) + x;
```

We have some tasks waiting in the readylist (9, 20 and 45):

7	6	5	4	3	2	1	0
15	14	13	12	11	10	9	8
23	22	21	20	19	18	17	16
31	30	29	28	27	26	25	24
39	38	37	36	35	34	33	32
47	46	45	44	43	42	41	40
55	54	53	52	51	50	49	48
63	62	61	60	59	58	57	56



AND

0	0	0	0	0	0	0	0
0	0	0	0	0	0	1	0
0	0	0	1	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	1	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0



So, OSRdyGrp is now

00100110

AND OSRdyTbl looks like this

0	0	0	0	0	0	0	0
0	0	0	0	0	0	1	0
0	0	0	1	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	1	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0



AND

```
y = OSUnMapTbl[OSRdyGrp];  
x = OSUnMapTbl[OSRdyTbl[y]]; p  
= (y << 3) + x;
```

OSRdyGrp is 00100110 (38)

SO,

```
Y = OSUnMapTbl[OSRdyGrp]; y  
= OSUnMapTbl[38];  
Y = 1
```



```
x = OSUnMapTbl[OSRdyTbl[y]];
```

```
OSRdyTbl[y] = OSRdyTbl[1];
```

```
OSRdyTbl[1] = 1
```

0	0	0	0	0	0	1	0
---	---	---	---	---	---	---	---

```
x = OSUnMapTbl[0]; x =
```

```
0
```

```
p = (y << 3) + x y
```

```
<< 3 = 1000
```

```
p = 8 + 1 = 9.
```

Then OS starts CONTEXT SWITCH –function...

Try the code.

Read more

MicroC/OS-II: The Real Time Kernel



Kakelino's Code School

Give feedback, please!
Give ideas, proposals for
new guides!

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